# CHEMICAL & METALLURGICAL ENGINEERING

McGraw-Hill Co., Inc. July 19, 1922 25 Cents Per Copy



**Send for this book**

**It points the way to**

## More profitable screening and crushing!

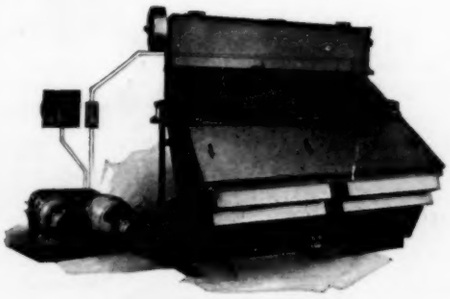
A FUND of valuable information on screening and crushing is contained in this 80-paged book on Hum-mer *Electric* Screens.

This remarkable screen makes screening and crushing more profitable—makes wire cloth screen faster and wear longer—and *makes screening a pleasure* in hundreds of plants throughout the United States.

$50,000 has been saved per year by one company through the installation of six Hum-mers. Another company saved $13,000 per year with one Hum-mer.

The Hum-mer process of screening is being employed profitably on over 75 different kinds of materials.

Investigate the Hum-mer now. *Don't let your competitor get the edge on you.*

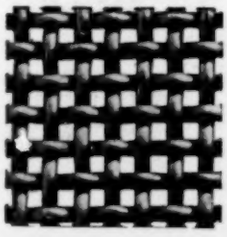


**Screens wet and dry materials from 2½" opening to 200 mesh.**

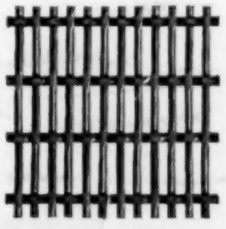
**Used on more than 75 kinds of material.**

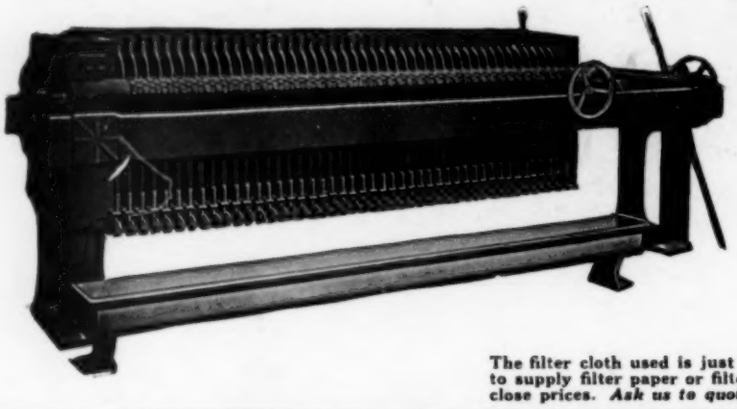
**THE W. S. TYLER COMPANY, *Cleveland, Ohio***

***Manufacturers of* Woven Wire Screens and Screening Equipment**



See Our Exhibit
At The
EIGHTH NATIONAL EXPOSITION
CHEMICAL INDUSTRIES
GRAND CENTRAL PALACE
NEW YORK CITY
Sept. 11-16, 1922





## Why You Should Use Shriver Filter Presses

The many exclusive features incorporated in the make-up of Shriver Filter Presses save time, labor and money. These advantages should make them the logical filter presses to use in your factory.

Simple in construction, skillfully designed and always reliable, Shriver Presses once used are always used.

Send for catalogue, illustrating and describing the many exclusive advantages of Shriver Presses.

**T. SHRIVER & CO.**
**808 Hamilton St., Harrison, N. J.**

**The filter cloth used is just as important as the filter press. We are in a position to supply filter paper or filter cloth especially woven for filter press work, at very close prices. *Ask us to quote on your filter cloth requirements.***

# DRYING MACHINERY

The most satisfactory, durable and economical dryers for

| | | |
|---|---|---|
| **CHEMICALS** | **LEATHER** | **TEXTILES** |
| **PAINT COLORS** | **CERAMICS** | **PULP BOARD** |
| **PHARMACEUTICALS** | **SOAP** | **HAIR, etc.** |

Proctor DRYERS

Standard types backed by long and successful records of service, or special designs for individual needs. Each "Proctor" Dryer is fully guaranteed as to capacity and results..

**PROCTOR & SCHWARTZ, Inc.**

**NEW YORK** **PHILADELPHIA, PA.** **CHICAGO**

# BALANCES

## Analytical, Assay, Torsion, Westphal and Other Forms

Analytical balances include our special Student model, the well-known 2J, the Chainomatic and many other forms. Assay balances range in sensivity from 1/50 to 1/500 mg. Westphal balances include the regular, the specially sensitive Young's and the Chainomatic. Among ordinary rough balances are moisture, solution and Torsion scales.

**WEIGHTS**

These are in stock for the most varied requirements.

***Write for Catalog section and give details***

**EIMER & AMEND**

***Established 1851***

***Headquarters for Laboratory Apparatus and Chemicals.***

**200 E. 19th St.**
**New York, N. Y.**

**WASHINGTON, D. C.**
***Display Room***
**Suite 601, Ev'n'g Star Bldg.**

**PITTSBURGH, PA.**
**4048 Jenkins Arcade**

# CHEMICAL & METALLURGICAL ENGINEERING

*A consolidation of*
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor



ELLWOOD HENDRICK
Consulting Editor
ERNEST E. THUM
Associate Editor
ALAN G. WIKOFF
Industrial Editor
J. S. NEGRU
Managing Editor

R. S. McBRIDE
SIDNEY D. KIRKPATRICK
A. E. BUCHANAN, JR.
GRAHAM L. MONTGOMERY
CHARLES WADSWORTH, 3D
CHARLES N. HULBURT
Assistant Editors



Volume 27 — New York, July 19, 1922 — Number 3


## Senate Rejects Dye Embargo

MUCH to the surprise of all interested in the dye and chemical industries of the United States, the Senate last week voted to eliminate from the tariff bill the item extending the embargo on dyes for a period of one year after the bill becomes law. It is quite evident that in taking this action the Senate was influenced by the Government's proceedings against the Chemical Foundation for the return of the German dye and drug patents sold by the Alien Property Custodian. Friends of the dye embargo were fearful that the Government's action would confuse the embargo issue in the minds of some senators and thus unfavorably affect the safety of that measure.

These fears proved to be only too true, for the vote on the embargo was preceded by violent attacks on the Chemical Foundation and the whole chemical industry. Senators Moses and King led the assault. It would be difficult to listen to Senator Moses and refrain from levity if the issue were not so momentous. He was alliterative but not convincing. He has long been the loyal servant in the Senate of the Amoskeag mills in New Hampshire and has consistently opposed the establishing of a dye industry in this country. As for Senator King, he was so thoroughly discredited in the dye investigation that he carries no weight.

But the fight is not over and the day is not yet lost. Senator Frelinghuysen announced that he would demand another vote on the proposal when the bill is considered in the Senate proper and not as committee of the whole. In the meantime it behooves all friends of the dye industry to see that their senators are under no misapprehension of the necessity for an embargo and are not confused by the proceedings of the Government against the Chemical Foundation.

## The Public's Interest in Settling the Coal Strike

AS IN THE CASE of practically all labor troubles, there are three parties involved in the coal strike —the miner, the operator and the coal consumer. The President's proposed plan of orderly settlement is eminently fair in that it looks primarily to the interest of the public. To set up an impartial tribunal to pass on the issues of a controversy in which workers and employers have failed to reach an agreement on their own initiative is assuredly in line with the best thought and sober judgment of the day. To capitulate to the demands of such an all-powerful and unreasoning force as the United Mine Workers would be a sacrifice of principles to which we cannot agree. Equally undesirable would be a surrender to any plan of the mine owner which does not offer a solution of the fundamental economic problems that underlie the coal industry.

The ranks of both miner and operator, if we see the situation rightly, are too close to the battle to get the broad perspective that is really needed. In concentrating their attention on the immediate difficulties and detailed problems arising out of the President's plan, they fail to appreciate the inherent possibility which this sort of settlement promises to their industry.

Before considering the public's interest in the coal strike, however, let us briefly review the operators' and miners' reaction to the plan. At first both seemed to be willing to accept the proposal "in principle," but at the same time were looking madly about in hopes of finding some means that would lead to its ultimate rejection. Finally, the miners took the responsibility of opposing public opinion by refusing to arbitrate. This was the cue for the operators to join with the public in piling high the blame on the other fellow and thoroughly punishing him for obstructing progress.

The operators see in the plan a victory for the unions, because the "uneconomic" wage scale, against which they have fought for almost four months, is now to be extended until August 10, and perhaps until March 1, 1923. In the opinion of *Coal Age* this is "to surrender to the campaign of intimidation, terrorism and massacre that has characterized the union's conduct in this strike." The labor officials' first reaction to the proposal was to question the motives of any possible representation of the public on the President's commission—apparently on the assumption that they will not receive fair treatment in the hands of any disinterested party. Such a stand is so obviously greedy as to be universally deprecated. The miners also appear to be opposed to the setting up of any agency such as the Railroad Labor Board, with power to handle wage rates permanently and to enforce their decisions. Such a plan may not be contemplated by the President, but there are those among the public who are inclined to regard it as a lasting solution for the bickering and bargaining that causes the constantly recurring labor difficulties in the coal industry. Furthermore, the miners insist that the recommendations of the commission apply to operators in all sections of the country, thus reopening the issue in partially unionized fields, where war-time wage scales have already been broken down.

The thing that the public is most interested in is a dependable supply of fuel produced by an efficient and properly functioning coal industry. The public will have none of the purely partisan demands of the operator and miner. As George Otis Smith has aptly said, "The people's coal costs too much because of the mistaken idea that mine owner and mine worker can continue indefinitely to fight over wages and rules. Cheaper coal and larger earnings will come when engineering is emphasized more and bargaining less. In terms of engineering, the coal industry has a bad load factor; translated into human relations, poorly func-

tioning mines mean poorly employed miners. This over-developed industry must suffer deflation; fewer mines can and should furnish the needed coal." In other words, the public wants to see this industry put on a fundamentally sound economic basis. If the President's impartial investigational commission can make recommendations that will ultimately result in the "establishment and maintenance of industrial peace in the coal industry and the elimination of waste due to intermittency and instability," then will the interest of the public have been adequately and honestly served.

## One of the Black Arts

"WERE IT NOT to be considered sarcasm, this industry might even be referred to as a 'black art,' first because of the usual secrecy regarding its processes and second, because of absolute dirtiness of the average electrode plant. Carbon works are generally regarded as fortifications through whose gates only the initiated may enter." This is the indictment one of our authors makes of a large and basically important chemical industry. This generalization, we are happy to record, is not universally true even in the electrode industry for we know some manufacturers whose works are always open to the technical public. And curiously enough, these are the plants in which the greatest progress in technology has been made.

Nevertheless one need but search through the very meager literature on electrode manufacture to realize how slow has been the spread of technical information in this industry. For this reason, if for no other, it is with some little pride that we direct our readers' attention to the important series of articles on the technology of the carbon-electrode industry which will be published by this magazine. The first of the series, appearing on pages 109-12 of this issue, is an account of the remarkable development of electrode manufacture. Rarely have we had the pleasure of publishing such an interesting bit of technical history. Were we searching for another explanation of the "black-art" characterization of the electrode industry, we would need go no further than to call attention to its almost magic development.

It is a long cry from 1800 and the little black rods of carbonized wood with which SIR HUMPHRY DAVY struck the first electric arc, to 1921 and the National Carbon's mammoth furnace electrode, 15 ft. long, 20 in. in diameter and weighing over a ton and a half. But 120 years is a comparatively long time when it is realized that in our own country in less than one-fifth of that time our output of electric-furnace electrodes has increased in value from $10,974 (in 1899) to well over $10,000,000 (in 1921). And were we to include electric-furnace products in that comparison the figures would be almost unbelievable!

To the Frenchman, CARRÉ, belongs the credit in 1876 for the first commercial manufacture of carbons. But he was followed closely by several Americans: DAVID THOMPSON of Newark, N. J., was probably the first American producer and it was CHARLES F. BRUSH of Cleveland who molded the first electrodes from petroleum coke and thus laid the real foundation of the industry. Brush, too, devised the calcination process and was the first to use really high pressure in molding and later in the interesting extrusion or "squirting" process of making electrodes. As the electric-furnace developments of SIEMENS, HEROULT, ACHESON and HALL took root in this country and grew so tremendously, the carbon industry was called on to supply an ever increasing volume of its products. With this demand came the need for gigantic electrodes capable of standing up under terrific service in the huge electric furnaces for making carbide, ferro-alloys and steel. And following this progress came the astounding evolution of the industry during the war. On the basis of such a record it is difficult even to hazard a guess as to the limits the industry may reach in the future.

Since the days of CARRÉ and SIEMENS, electrode manufacture has been practically revolutionized by the introduction of modern labor-saving machinery. Much of the progress of the industry is doubtless attributable to the use of large-scale and scientifically controlled equipment. It is believed, therefore, that more than usual interest will attach to the succeeding articles of this series, most of which are intimately concerned with the design and operation of equipment used in the calcining, molding, extrusion and baking processes. In offering these articles to our readers it is with the hope that they will arouse the sort of criticism and comment that will ultimately benefit the carbon industry. Only through the free interchange of information regarding its fundamental technology can this industry dispell the gloom of mysticism and secrecy which has characterized its past.

## Are You Guilty of Meticulous Precision?

WE WERE fortunate enough to study quantitative analysis under a professor who invariably did the following thing: If an analysis were reported as 7.0125 per cent and the accuracy of the analysis allowed only two decimal places, the professor marked the result wrong. Many a young and enthusiastic analyst protested vigorously at this summary treatment, but by that same token many a young and enthusiastic analyst learned a lesson which he never forgot and so, too, did the rest of the class. $2 + 2 = 4$ and not 4.0000. But analysts are not alone in falling into this error. Engineers are notorious offenders.

We recall one instance where a celebrated engineer was preparing a set of tables for publication and was using a set of twelve-place logarithms. We asked why he used twelve-place tables and he replied that they were the best he could find, that he had heard there were twenty-place tables but he had been unable to locate them. The interesting thing about this anecdote is that practically all the data which the celebrated engineer was tabulating had an accuracy which was seldom better than 1 per cent and an ordinary 12-in. slide-rule would have been amply accurate for the work.

Again, when a young engineer is about to make a mathematical calculation, say for example the surface of heating coils necessary to obtain certain results, he will almost invariably sit down and calculate it to an accuracy of a tenth or even a hundredth of 1 per cent and this in spite of the fact that the constant factor in the equation (the rate of heat transfer) may not be known within 50 per cent.

Herein lies one excellent reason why many a practical man with good common sense and a wide experience has been able to compete with engineers in many fields. The engineer frequently has technical training only, with no balance wheel of common sense that would tell

him that a given result, although mathematically correct, is logically absurd.

We have attended conferences and conventions on engineering education and have heard some studies characterized as a waste of time for an engineer taking a four-year course. Yet we always wonder if that very course in some institution may not be the one to give the student the balance he needs almost more than anything else in his technical work. Perhaps the professor who gives that particular course is the one who would best accomplish that much-to-be-desired result. Through every phase of the chemical field and through almost every profession we find the need of a sense of balance and proportion, the ability to stand off and look with perspective at a given problem and say, "Here and here are the important things, the rest are ciphers beyond the limit of accuracy of the problem." And so whenever we come in contact with some lack of balance, on the part of technical men in particular, we bless the professor of quantitative analysis who marked us wrong when we said that $2 + 2 = 4.0000$.

## Turning Accident Into Disaster

TWO WEEKS AGO the City of New York was shocked by an accident in its subway system resulting from the use of pyrene, a carbon tetrachloride fire extinguisher, in an attempt to extinguish an electric arc. About 150 men and women were overcome by the resulting fumes and the city's fire and police departments were summoned to the rescue. Some of the passengers were seriously affected and confined to the hospital although most of them soon recovered from their involuntary "gassing."

The incident is one of special interest to chemists and technical men because it furnishes another example of the direct relation of chemistry to the public welfare. The resulting investigation has shown what was already common technical knowledge, namely, that carbon tetrachloride sprayed on heated surfaces in a small enclosure gives rise to fumes of phosgene and sometimes chlorine and hydrochloric acid. The unfortunate feature of the affair was that a slight accident resulting from a short circuit in a switch box, which need not have had serious consequences, was turned into a near tragedy by the ignorant use of a fire extinguisher with which subway cars never should have been equipped.

Accidents of this kind always emphasize the great problem of widely disseminating the knowledge that is held by specialists and which is available for the public if it knew where to seek it. The U. S. Bureau of Mines, for example, has long since investigated carbon tetrachloride fire extinguishers and has made known in a technical paper by Fieldner, Katz and Kinney, all of the facts necessary to forestall the use of such devices in subway trains. But how shall the results of such investigations, duly recorded in a government publication, be given the wide publicity they deserve? It may be said to the credit of the Transit Commission that its investigation led it to call upon the Bureau of Mines for advice, but apparently no one thought of seeking it before the accident demanded it. One cannot help feeling that the manufacturers owed a duty to the public which would have led them to refuse to sell a fire extinguisher of this kind for use where it could have such terrible consequences. An order has since been issued to discontinue the use of pyrene in subway cars, but there are still millions of people in the country who may suffer a distressing and even fatal accident if they are not informed on the proper use of carbon tetrachloride in putting out fires. It should not be used in small enclosures. Chemists generally can be of great service in spreading this information.

## Science and The Daily Press

SOMETIME ago the Washington *Star* published under the caption "Faith in Science" an editorial that was most encouraging because it indicated a truer appreciation of science on the part of the daily press. It led us to believe that the day is approaching when we can expect to read in our daily newspapers reliable and trustworthy items on scientific progress instead of the scare-head stuff that still seems to meet newspaper standards and ideals. The editorial in question related how once it was "the fashion to class all researchers and inventors with the perpetual motion cranks." But it went on to show the change that is taking place in the public's appreciation of science, as a result of which research and invention are now accorded the dignity they deserve.

This is fine as an editorial expression but it would be finer still if it found practical application in a censorship of the contents of newspapers. The daily press is, and for many years will continue to be, the great medium of publicity through which the public can get a general impression of science and technology. This entails a duty which is far from being performed and a responsibility which has not yet been met. While we have occasional evidence of editorial sanity as indicated in the Washington *Star*, news columns are still filled with alleged scientific stories that are played up by the energetic reporter with a nose for news. In other words, the standards avowed on the editorial page find no expression in the news columns, which, incidentally, is one of the most radical differences between the daily and the technical press.

As yet the newspaper editor makes no discrimination between the announcement of a discovery or invention by an Einstein or a Marconi, and a nondescript screed on the alleged discovery of "life crystals" by Mrs. Maud Dickinson of Brighton, England, hitherto unknown to fame. Columns are devoted to her alleged discoveries because they are shrouded in mystery and because she has been bold enough, or foolish enough, to announce that perhaps she has discovered "the source of all life." Perhaps! Certainly she has discovered a great source of publicity. She talks of "a self-created scarab or beetle of old Egypt" which in some marvelous manner "formed crystals outside and away from the bottle in which it was kept." It staggers the imagination to think what the scarab might accomplish if turned loose instead of being kept in close confinement. It is reported further that "the discovery was made by accident." We can believe it. Why not investigate the accident and find out what really happened instead of leaving our minds confused with vague references suggestive of alchemy, mythology or clairvoyance.

The daily press has a greater responsibility than it realizes in passing out this kind of scientific bunkum to the people. In many respects daily journalism is on a high plane, but its editors have not yet learned to throw such stuff into the waste basket.

# Readers' Views and Comments

## Effects of Impurities on Electrolytic Zinc

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—Dr. Scholl's data presented in his paper "Effects of Impurities on Electrolytic Zinc," in *Chemical & Metallurgical Engineering* for March 29, 1922 (vol. 26, p. 595), reasonably confirm the data already published by a number of investigators of this same question.

His photographs, however, appear to me to indicate that his observations were complicated by "doped" solutions—i.e., solutions containing glue or something analogous to it. The striations shown are, I think, invariably due to hydrogen liberated at the cathode and rising through the solution along the cathode surface. Liberation of hydrogen in quantity bespeaks low current efficiency, so, in one way, it is legitimate to refer the striations to the causative impurities.

The various protuberances, "warts," "trees," "sprouts"—whatever you may care to call them—which, as Dr. Scholl's photographs show, become more strongly marked as deposition goes on, can be more readily produced by adding glue-like materials to solution than by any other method I know of. It is my own impression that they are more nearly a characteristic of the "addition agent" and of the quantity of "addition agent" added than they are of specific inorganic solution impurities.

### IMPURITIES ACCELERATE EFFICIENCY DROP

In my own experience, the current efficiency of a zinc cell invariably falls off as deposition goes on (everything else—acidity, temperature, etc.—being kept constant). In pure electrolytes the initial current efficiency is high and the rate of decrease nominal. In impure solutions the initial current efficiency may be fairly high, but the rate of decrease is also high—i.e., I doubt that with certain impurities one does get normally high current efficiencies over a period of several hours and then a sudden inversion when all other factors affecting deposition are rigidly kept constant.

Glue and other glue-like addition agents are oxidized in the cell—i.e., glue concentration changes continuously within a closed cell circuit. I do not understand the action of the glue in spite of much that has been written concerning its action, but I have seen such apparent inversions of current efficiency as Dr. Scholl reports and still it has seemed to me that I could always find some reason for a sudden inversion that did not inhere in the impurity *per se*.

Of the papers concerning the effects of impurities upon zinc deposition that have been published so far, the one that has seemed to me to most nearly correlate observed data is that by Tainton (American Electrochemical Society *Transactions*, 1922). Tainton attributes the effects of impurities to the relative overvoltages for hydrogen of the impurities and of zinc. Zinc, of course, could not be deposited from aqueous solutions were it not that zinc does so strenuously object to having hydrogen deposited at its surface.

I know of but one or two observations that indicate need for something more in the way of explanation than the overvoltage theory, and it may readily be that these can be shown to be incorrect observations.

Iron has about the same overvoltage as cobalt and nickel. The zinc cell is not nearly so sensitive to the presence of iron in solution as it is to the presence of cobalt or nickel.

Solutions containing manganese are particularly sensitive to antimony and only slightly less sensitive to arsenic. If these solutions are treated with permanganates in such manner as to remove all manganese, the arsenic and antimony are usually also eliminated—particularly if ferric salts are precipitated. Solutions so treated yield zinc at maximum current efficiencies, and these solutions are relatively insensitive to the addition of arsenic and antimony. I have electrolyzed such solutions after addition of 17 parts of antimony per million, and, if I remember correctly, Mr. Lee at Trail told me he had added the better part a gram of arsenic per liter (1,000 parts per million) to similarly treated solutions, and yet these solutions yielded zinc at very high current efficiencies.

Unfortunately, one's conclusions from given experimental results are subject to change as an art develops, and I think much of our present perplexity might be set aside by repeating early experiments and interpreting the results in the light of more recently acquired knowledge.

C. A. HANSEN.

General Electric Co.,
Schenectady, N. Y.

---

## New Vogue in German Dyes for Socks

*To the Editor of Chemical & Metallurgical Engineering*

SIR:—I have just returned from Wonderland. I never appreciated before just how wonderful a country it is. Before leaving these shores of Bungle Land, I had become thoroughly convinced that since *der Wacht* no longer *fest steht und treu* on the Rhine, the dyes of Wonderland constituted the one peerless example of permanency in this world of "relatively" changeable things. Of course, this is so. But the dye chemists of Wonderland have improved on permanency. Of course, to observe all the rules of testimony, witness should be duly sworn and submit his exhibits. The exhibits, however, in this case are my feet, and since *Chemical & Metallurgical Engineering* does not publish multi-colored plates, witness will simply have to depose that having bought a number of otherwise very excellent socks in Germany, his feet are now dyed a beautiful brilliant green.

It is obvious that this is a great improvement in socks and is doubtless fully protected by a Deutsches Reich Patent. Some people would prefer perhaps to have pink toes but this can doubtless be arranged with the master dye-makers of Wonderland. In my case the result, while perhaps not *kolossal*, is at least *tadelos und wunderschoen*. Probably the inventor of this improvement got his idea from the dyed papers with which in former years we used to transfer wonderful dyed patterns to Easter eggs. Nevertheless, it is a great idea and I felt that I should mention it to show how far behind times our dye chemists of Bungle Land really are.

B. T. B.

New York City.

**Article V in This Series and the First Article on Accounting—The Calculation of Chemical Efficiency or Yield in Different Types of Chemical Plants—Errors in Plant Accounting Methods**

# The Business Side of Chemical Manufacturing

By Charles Wadsworth 3d

THERE OUGHT to be a fable about a man who felt so keenly the importance of the subject about which he was going to talk or write that he choked to death trying to enunciate some superlatives which would, in his estimation, be adequate to the situation. If there were such a fable, I should invoke it at this time. The importance of accounting in chemical manufacturing is so great, so vital and so essential to the success of any one unit, that there are not enough superlatives to make the point sufficiently impressive.

Couple with this the fact that technical men in chemical manufacturing industries are almost completely ignorant of accounting and that even the chemical executives and manufacturers do not possess a wide knowledge of the application of accounting principles to manufacturing problems nor any understanding of the interpretation of accounts. All these things contribute in making any one familiar with the benefits which accrue from the application of accurate accounting to manufacturing industries adopt the attitude of an irate pedagogue towards an unusually stupid and recalcitrant pupil.

In these brief articles, we hope only to emphasize the importance of accounting to chemical industries and to point out a few of the weaknesses of existing systems. Turn your attention to the accounting department and to accounting methods whether you are an executive or an analyst. Look at the forms that are used and discover for yourself how accurate the present system is and to what variations it is subject. This article will discuss plant accounting and the last article in the series deals with costs and cost finding systems. When you realize that less than five per cent of the business houses in this country have cost systems, the truth of the often-quoted statement is brought home to you: "It would be better for most business houses in this country to shut up shop and throw dice for a living—their chances of success would be greatly improved."

## Chemical Plant Accounting

### Are Accurate Production Efficiency Figures Important?

An accurate production efficiency or, as it is more generally called, yield figure, is the pulse of a chemical plant. It would seem to be pretty obvious that an inaccurate yield figure is worse than useless, because it is misleading. It is strange that it should be necessary to point out this rather fundamental truth and yet company after company gives allegiance to a system which cannot produce accurate yield figures. We will take up, a little later on, some of the errors which invalidate yield calculations and estimates.

A true manufacturing yield should and can accomplish three things. It will reveal the chemical efficiency of the process in question. Further, in revealing this efficiency, it will open the way toward improving it. Finally, it will give a reliable line on the work of the manufacturing man. Too often it is impossible now to answer the question, "How well is Jones doing with such and such a unit?" These benefits all have to do with the manufacturing unit itself and do not take up the consideration of the rest of the organization. In addition, true manufacturing yields form a basis of accurate costs and accurate costs are the criteria upon which executive decision must be based. It will be seen then that the cornerstone of intelligent executive action lies in an accurate and workable system of plant accounting.

### What Do You Mean—Plant Account?

So far as can be summarized briefly, plant accounts should give consumption of raw materials, production of finished products and the efficiency obtained in the process. Obviously, different kinds of chemical processes require different accounting systems. In the first place, there are to be differentiated small batch processes as distinguished from large scale or continuous processes. It must be apparent that the accounting system for a batch process will in general be simpler than that of a continuous process. With a continuous process there will be no definite point at which you can say, this much product came from that much raw material. There will always be material going in to be consumed and there will be a somewhat indeterminate quantity of material in process. Allowances must duly be made for this condition.

This is only one of a large number of groups into which chemical plants may be divided. Each separate group will need a different accounting system and the number of different systems becomes legion. We shall try to develop some typical examples of methods of recording data and calculating yields, indicating the changes which are necessary when complications arise in the type of process.

There are a good many ways of expressing plant yield or efficiency. The most scientific method of course is to calculate the theoretical yield which should be obtained from a given amount of raw material and divide this into the amount actually obtained. The quotient, with proper decimal point, is the per cent of theoretical or ideal efficiency. This figure is an absolute as well as a comparative figure.

In many firms you will find a peculiar survival in use. Two hundred and fifty per cent yield! How would that appeal to you? Unfortunately, all that it means is that pound for pound you get a quantity of product equal to 2½ times the original weight of one of the raw materials. It is an entirely empirical figure and the actual weight produced per day would be just as good, assuming you consumed a consistent amount of raw material. It does serve as a comparative figure however from one month to the next.

Expressed in lowest terms then we must know how much material goes into a process and how much prod-

uct comes out. These, with the elementary chemical equation, are all that it is necessary to know to calculate yield.

### A Few Complications in Yield Calculations

When two or more raw materials are used in manufacturing the same product, there arises some complication as to which shall be used as a basis on which to calculate the yield. For example, sulphuric acid and salt are both used in making hydrochloric acid. The yield based upon the salt used will not be the same as that referred to sulphuric acid. In such a quandary, it is a frequent practice to refer the yield to the most expensive raw material. This in turn is usually the material which is not used in excess, but from which you should get a definite and molecular quantity of product. In some cases the most expensive raw material is used in excess and in such cases it is more usual to calculate on the basis of the material which is used in the proper proportion to produce molecular quantities of the product.

Still another complication arises when two or more products are produced from the same raw material. Our illustration used above still applies, for both sodium sulphate and hydrochloric acid are produced at the same time from sulphuric acid and salt. Now the yields of sodium sulphate based on sulphuric acid or on common salt will differ from each other and also from those yields based on the production of hydrochloric acid. In order to calculate the efficiency of the process, it is usually customary to take the more desirable product and refer it to the raw material used in molecular quantities and not in excess.

Again, in some chemical reactions, one product is made at the expense of another product as in the case of the di-substituted aromatic organic compounds when both ortho and para are formed in varying amounts, depending on conditions. Here, assuming we want paranitrophenol instead of orthonitrophenol, the yield would be expressed in terms of the para product referred to the nitrophenol equivalent of the phenol used.

The case of expressed oils or extraction processes is not infrequently met in chemical processes. It is difficult to obtain a representative sample of the raw material and this is particularly true when the material is of vegetable origin and a certain amount of soluble material is to be extracted or pressed from the crude. If we take a sample of copra, for example, it is a difficult matter to obtain a laboratory figure which will represent accurately its coconut oil content. This is due to a number of things, the greatest of which is the mechanical difficulty of sampling tons of material accurately and putting it into an extraction thimble in the laboratory. Thus we would be able to weigh the copra and to obtain accurate samples and weights of the expressed coconut oil, but we would not know accurately what per cent of the oil was extracted in the process.

Finally, there are processes such as the fractional distillation of petroleum or coal tar, in which an ordinarily expressed yield is not significant since the products are so numerous. Plants such as those for making portland cement in which the finished slag is never weighed nor estimated accurately present another difficulty. In these cases a yield is not significant at all, except over a period of, say six months or better still, a year. Then a rough estimate of the slag pile can be made and the quantity in the slag pile will perhaps represent only a small per cent of the total production, whereas over a shorter period of time the variations in estimating this slag pile would be so great as to vitiate any yield results at all.

## Simplest Type of Plant Account

### The Small Batch Process

For purposes of illustration we shall take an entirely fictitious process—the formation of glaubers salt from caustic soda and sulphuric acid. Let us assume first that we are to produce 500 lb. a day. This is analagous to hundreds of processes in use now for the production of fine chemicals. In making 500 lb. of glaubers salt, we would use 127 lb. of caustic soda (76 per cent $Na_2O$) and 163 lb. of oil of vitriol (93 per cent $H_2SO_4$). In using such small quantities of material, it is customary and safe to trust the daily weights which go into the process. The materials used on this scale are usually expensive and the operating system is so arranged that variations in weight of the raw materials are slight and easily checked. In this type of process it is not infrequently the custom for the purchasing agent to be responsible for stocks of material. They are used in such small quantities that the daily increment is only a small part of any given shipment. The date for replenishing stock can, therefore, be plotted with periodic regularity. The accounting data required from this type of plant are few. They may be recorded with a great many operating data, but we are not at present concerned with these. Below is printed a sample form which might be used in this glaubers salt process.

1. Weight caustic soda (76% $Na_2O$) used.....
2. Weight oil vitriol (93% $H_2SO_4$) used.....
3. Theoretical quantity glaubers salt obtained from caustic soda used.....
4. Actual quantity obtained.....
5. Plant Efficiency or Yield $\left(\frac{\text{No. 4}}{\text{No. 3}}\right)$ .....

An analysis of raw materials is necessary in a small plant such as the one we are describing if only to check up the purchasing specifications. No rigid system or form should be necessary for reporting the analysis. There is great danger in small plants of running system into the ground and of having rigidly prescibed procedure for situations that do not happen more often than once a quarter or once a year. If the plant becomes larger and the units increase in number it is necessary to have a rigid system for reporting analysis of raw materials and even for getting samples of these raw materials. It also becomes necessary then for the operating men to take care of the stocks on hand and requisition the purchasing department in time to replenish them. All these things are operating details but have considerable bearing on accounting, due to the fact that plant yield and cost must be calculated on a basis of these operating reports.

From this simplest form of plant account there develops all degrees of complication in methods. We shall discuss in detail next a complicated system used in large batch processes or continuous processes. It will be impossible to take up all the necessary forms and we have therefore printed a fac-simile of the general summary of plant-yield indicating such supple-

mentary forms as are customary. The gaps between these two types can be interpolated with the help of the general principle—"Don't put in a single form that isn't essential. If you can do without it, *do!*"

### Effect of Increasing the Size of the Plant Upon Accounting Methods

Instead of making 500 lb. of glaubers salt per day, imagine the plant turning out 50,000 lb. per day, or 25 tons. Obviously the consumption of 12,700 lb. of caustic soda and of 16,300 lb. of sulphuric acid is a very different mechanical problem from 127 lb. and 163 lb. In the first place, although the raw material is invariably weighed or measured in some way as it goes into the process, there will inevitably be inaccuracies in such figures in plants of this magnitude because of the low intelligence of the labor ordinarily employed in operating work. Yield figures cannot be calculated from the process weight and hence we cannot obtain a yield figure from a daily batch unless we check that figure by estimating the stock of materials on hand and calculating from these the consumption during the day. This would be entirely out of the question because of the expense involved and therefore, it is usual to take a given period, say a week or fortnight or even a month, and to calculate the stock of materials on hand at the beginning and at the end of the period. Then the consumption of raw material is equal to the stock on hand at the beginning of the period, plus the receipts of raw material in the plant, minus the stock on hand at the end of the period.

It is obvious, of course, that with a plant of this size a very much larger stock of material must be kept on hand than in the first case. A month's supply would be 381,000 lb. of caustic soda and 489,000 lb. of oil of vitriol. It is a comparatively simple matter to estimate the stock of material on hand with great accuracy when the goods are in packages or containers of fairly standard weight, or when the material is a liquid and stored in tanks. When, however, you are dealing with bulk material in piles or bins the estimate is not nearly so accurate. Errors in estimating stock of bulk material are of two kinds. In the first place, it may be due to an inaccuracy in estimating the cubical content of the pile and in the second place, it may be due to employing a wrong specific weight factor. If two separate measurements on a pile of coal or brimstone check within 1 per cent, the measurers may call it a day. It is just about as close as can be averaged on successive checks. Closer checks are often the brag of various plants and organizations, but they are hardly ever consistently closer. It is a very easy matter indeed to miss a measurement by a few inches and obtain a startlingly different result. Thirty-five per cent variation is not an uncommon experience although when rechecked, one of the measurements will be found to be grossly in error.

The second error arises from the use of inaccurate specific weight factors (the weight of a cubic foot) with which to convert cubical content of piles into weight. Variations in this factor are often due to the fact that material packed in piles is not nearly so densely crowded at the top as at the bottom. Frequently too, raw material from different sources has a different specific weight and due to a somewhat inflexible system, this is overlooked in many factories. Other factors, such as moisture content, frequently affect the packing of the material. The product of our fictitious plant, glaubers salt, is an example of this. It is usually stored in bins as wet crystals without any drying. Actual contents of a given bin vary greatly and only a rough approximation of the stock of materials can be made.

### Correction for Stocks in Operation

Whenever the amount of material tied up in manufacturing becomes an appreciable per cent of the production during the given period it must be corrected for. In other words, the stock of material at the beginning of the period may not be the same as the stock of material in operation at the end of the period. Obviously this would have an effect on the consumption of raw material and consequently on the plant yield. This is a nuisance to the plant men and therefore, unless the system is sufficiently rigid and carefully supervised, the results are likely to be quite inaccurate.

The yield records in this type of plant are considerably more involved. The insert gives a log sheet of our fictitious plant for producing 25 tons of glaubers salt per day.

In addition to the form shown, which acts as a summary, it is necessary to have a detailed report on the stock of raw materials and finished product and the quantity of materials in operation. This requires an itemized summary of the material in every piece of equipment together with some chemical analysis or density measurement to translate volume into weight. In some plants this can be combined with the above report.

PRODUCTION OF GLAUBERS SALT

Period ending.....

CONSUMPTION OF RAW MATERIALS

| Caustic Soda | | Oil of Vitriol | |
|---|---|---|---|
| Stock last report | | Stock last report | |
| Shipments received | | Shipments received | |
| Total (A) | | Total (E) | |
| Stock on hand | | Stock on hand | |
| No. of drums | | Tank 1 ..... in.= | lb. |
| Average weight | | Tank 2 ..... in.= | lb. |
| Total weight (B) | | Total (F) | lb. |
| Consumption (A-B) | | Consumption (E—F) | |

PRODUCTION

| | |
|---|---|
| Stock on hand | |
| Materials in operation | |
| Sales shipments | |
| Total (M) | |
| Stock on hand (beginning of period) | |
| Materials in operation (beginning of period) | |
| Total (N) | |
| P. Production (M-N) | |

YIELD

| | |
|---|---|
| R. Theoretical production from caustic soda consumed | |
| Yield (Efficiency) P/R | |

In taking an inventory in this type of plant the volume, density and chemical analysis of each container must be obtained. Sometimes the analysis can be reduced to a specific gravity determination with proper allowance for temperature. I should have written the last four words in capitals, for there are a great many plants that disregard this completely, curious though it may seem and their actual results are thrown out by as much as 5 to 10 per cent on this account in some instances.

Still another rather foolishly obvious precaution is that the chemical condition of the material in operation should be considered, yet many a time an estimate of material in operation is made as though it were all raw material and not part changed to the product. All these things have their effect on the ultimate yield.

With such variations in the estimates of the stocks

of materials on hand and in operation, both of which affect the consumption and production figures, it must be obvious that a period of no stock on hand would be extremely desirable. The equivalent of this can be obtained by splitting shipments into various bins so that one bin will be entirely cleaned out and another bin containing a definite quantity of material would be all the stock on hand at that time. This procedure is perfectly possible in all plants and should be undertaken at least every fortnight. In this way, constant checks on the stock of raw materials can be made. Scores of companies however, have only one bin or pile to which they add and from which they take at the same time. This continues for years oftentimes and the overages and shortages amount to absurdly high quantities.

## The Personal Element in Plant Yield

### The Executive Demand for Consistent Yield As a Cause of Inaccurate Yield

When an executive looks over a set of yield figures, he usually compares them with those of the previous month and inquires about those that show marked changes. "What are the reasons?" he asks. This request is transmitted through the usual channels until it finally reaches the operating man in charge of the unit. Usually he is unable to explain the inconsistency and is considerably embarrassed by the searchlight of investigation. Therefore, next time he takes some pains to avoid a repetition of the inquiry. In other words, he usually adjusts his yield so that it will be consistent with the last month's yield. This can be done very easily by subtracting from or adding to the stocks in operation. Then next month or next fortnight, whenever the next calculation is made, he balances up his stock so that over a period of months there will be no great shortage or average so far as his measurements are concerned and his yields will be reasonably consistent. Therefore, executive attention ceases to be focused on that unit.

### Too Much Emphasis on High Yields Unwise

Still another phase of the same problem is the desire on the part of operating men to obtain high yields. Praise is usually lavished on high production and yield. There is a great tendency toward dishonest boosting of yields, due to this fact. A great many executives flatter themselves that dishonesty does not exist in their plant and a large majority of them are being awfully well fooled on that point. They will point with pride to the one or two men who are discharged for dishonest practices—they are the men who are caught. Many ingenious methods have been devised to beat the game. Sometimes they will cheat another unit from which a raw material is obtained without its knowing it. Sometimes it is possible to consume more material than is recorded and to run ultimately into a shortage which, in the average plant audit, cannot be pinned on to them, due to a number of possible flaws in the system, such as inaccurate weight delivered to the plant, unreliable inventory measurements, etc. The operating men cannot be blamed too much for this situation. It is a product of their environment and of the system. If executives would remove the tendency toward dishonesty, there would be no dishonesty. This can be done by setting a premium on accuracy of yield rather than on efficiency and high yields.

### Executive Sense of Balance Necessary

The effect of dishonesty on plant yield figures is as disastrous. It makes them useless. The first job of a plant executive should be to understand the operating methods so thoroughly that he is certain of the accounting system and knows accurately the possible variables. It is somewhat amusing but more pathetic to see a solemn conference as to why such and such a unit dropped 2 points in yield and to realize that the yield cannot be calculated more accurately than plus or minus 5 points. The trouble is not with an individual executive so much as with the system. The plant executive is asked those questions by his superior who is more and more out of touch with plant methods and he must give the answer which the plant operator gives to him. He can object to the question and point out the fact that it is foolish to worry about so small a variation when you don't know the figure as accurately as that, but generally he does not know this and would not dare say so if he did know it. So in turn, he demands of his subordinate the same unintelligent analysis and therefore, we have a continuation of these absurd conferences, all of them trying to "pass the buck" on a question that had no right to be asked in the first place.

The problem of accurate yield is then twofold. First, a system must be installed upon which reliance can be placed, and second, a personnel must be developed which is in sympathy with the system and which understands it thoroughly. There is not space here to discuss the problem adequately. We have developed some of the underlying principles and pointed out some obvious weaknesses in existing systems. It is vital to emphasize the necessity of intelligent work on this problem. It lies at the root of accurate costs and the whole morale of the organization may be undermined because the system under which it works is lax and permits and even encourages dishonesty.

---

## Use of Rubber in Road Making

Experiments are being carried out by the Colombo municipality in the use of rubber as a road-surface dressing, according to *Commerce Reports* for July 3. The dressing, which is the invention of a Ceylon rubber planter, is now being used on a portion of Darley Road, which is one of the most used thoroughfares in Colombo, Ceylon. This solution was first tried on a road of the Deviturai rubber estate, where it has been in use for the past 13 months. A short stretch was later laid in the municipality of Galle. The present test, however, is the hardest to which the new solution has been put.

The solution is made from pure bark and scrap rubber. The method of laying is similar to that employed with tar and asphalt preparations, it being heated until liquid and then spread on the road with brooms. Fine gravel is then sprinkled over the solution and a steam roller binds the two.

The experiments so far show that this solution is easier to handle than tar. It is a secret formula and the inventor is still working toward its perfection. He hopes to evolve a solution which may not only be used as a binder, but also may be spread to a depth of 1 or 1½ inches so as to be a road surface in itself.

The cost of the liquid-rubber road dressing is 50 to 75 per cent more than that of tar, but it is expected to last two or three times as long.

# The Native Sugar Industry of Szechuen Province, Western China

By H. K. Richardson

THE sugar district of Szechuen province, China, is a rather sharply defined area of about three thousand square miles. The most important section of the district parallels the main road from Chengtu to Chungking for a distance of 100 miles between the cities of Chien Chou and Nei Chiang. Fig. 1 shows a sketch map of the territory. The Lu Ho River runs the whole length of this section and serves as a cheap distribution system whereby the sugar products reach about half the population of the province, or 30,000,000 people.

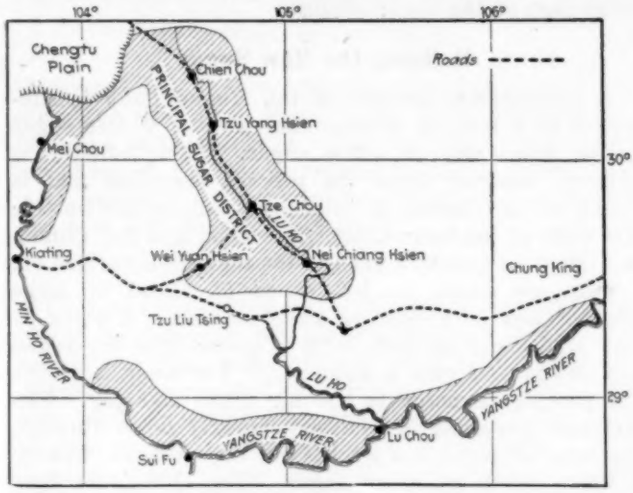



FIG. 1—SUGAR DISTRICT. SZECHUEN PROVINCE, CHINA
Shaded portions represent principal producing sections.

On one trip through this section the writer has seen ten crushing and evaporating houses within a radius of a mile. About half of all the land was given over to the growth of sugar cane. This preponderance of sugar interest holds all over the section.

In *Commerce Reports* for 1915, Consul-General Baker estimated that this section produced about 240,000,000 lb. of sugar per year. From personal observation and Chinese sources the writer feels that about 150,000,000 lb. would be a better figure. Even this is about half the Louisiana crop of 1920-21.

There are two other nearby sections where the growing of cane is a sizable industry. One of these is the river banks of the Yangstze from Sui Fu to Chungking. Hosie in his "Report on Ssuch'uen" speaks of this as a large sugar country. Although the author has seen this cane growing, he has never been in a position to judge of its extent inland. The other section is the banks of the Fu Ho between Kiating and Mei Chou, where the writer has seen wonderful stands of cane ripening in October. Small patches of cane are grown all over the province in favored spots, but these contribute very little to the sugar industry, being used locally for chewing.

## Growing of the Cane

There are three kinds of sugar cane grown in Szechuen: *Hong Gan* or red cane, *Lo Han* or large white cane and *Lu Ma Gan*, a small white cane.

The red cane, or *Saccharum officinarum var. rubricaule*, grows to a height of 8 ft., with a heavy stalk 1¼ to 1½ in. in diameter. The joints are 8 to 12 in.

FIG. 2—RED SUGAR CANE MARKET

long. The stalk alone is 5 ft. long and weighs about 4 lb. This cane is used exclusively for chewing purposes. A single stalk sells for 80 to 90 cash (3 cents) and is cut up by the retailer and sold in small pieces at a few cash each. This takes the place of chewing gum for the Chinese.

The red variety is grown in quantity outside the regular district. Tze Chang, Pa Chow, Kai Hsien and Ho Chow are famous markets for this variety. The cane is a quick grower. It is planted in February and is ready for use in August, although left standing until frost in December. A supply is stored in pits under cover of the leaves and is used till the new crop arrives. It is said that the red color or the sweetness does not develop until the leaves are stripped from the stalk. A red cane market is shown in Fig. 2.

Wilson, in "A Naturalist in West China," calls all the white cane *Sacchrum officinarum var. sinense*, but the Chinese distinguish two canes as indicated above. The two canes vary only in size, the large being about 1½ in. in diameter, while the smaller is slightly under an inch in diameter. The canes grow 10 to 15 ft. high and are 7 ft. when topped, with twelve to fourteen joints. A load of twenty stalks of the large variety will weigh 80 lb. They sell at the market for 10 cash a catty (1.33 lb.) or about ¼ cent per lb.

These canes are planted in February and harvested in December or January or before frost. The tops alone are used for the planting. They are laid flat in trenches 18 to 24 in. apart. Four to ten sprouts come up from each joint, only three or four of which are permitted to mature. A small stand of this cane is shown in Fig. 3.

FIG. 3—STAND OF SUGAR CANE IN NOVEMBER, NEAR TZECHOW SZE

The land is planted to cane on alternate years only. Wheat, peas and beans are the crops in the intervals. In a few cases the small white cane is used as a perennial, two or three crops being taken from one root.

## Raw Sugar Production

### CRUSHING

The crushing of the cane and the evaporating of the juice is always done near the cane fields and away from the cities. The ripened cane is cut by hand and carried to the crushing mills by coolies. The cane is crushed between vertical stone rollers, driven by cows or buffalos. Two limestone rollers are provided with holes around their upper sections, into which oak wedges are driven. These wedges or cogs engage as gears so that the two rolls revolve together but in opposite directions. The rollers have wooden shafts in each end. The lower shafts are provided with iron inserts and rest upon iron ball bearings. The upper shafts project through a large beam supported on stone pillars. The drive roll shaft extends 4 ft. above the beam. To this is tied a bent arm carrying the harness for five draft animals. The driven roll is held against the drive roll by means of a filler block and wedge set in the beam against the upper shaft of the driven roll. The cane is fed through a hollow cast-iron guide shaped to the rolls. About 10,000 catties (13,333 lb.) of cane is crushed per day, two passages through the crusher being the usual practice. Fig. 4 is a photo and Fig. 5 a cross-section of such a mill in the Chien Chou section.

### EVAPORATING

The juice from the rolls runs by gravity to a receiving tank in the evaporator house near the crushing mill. Here a series of iron pans 2 ft. in diameter are set into brick and Chinese cement over a grate and flue. The weak juice is placed into one of the three pans over the grate and dipped up into the pans along the flue as it thickens, thus following direct-current rather than counter-current practice. The last pan in the series is placed to one side of the flue and is called the cold pan. When the juice has reached the right thickness, it is thrown into this cold pan and beaten with an iron paddle until it crystallizes. It is then poured while hot into bamboo basket containers, holding about 40 lb. and permitted to cool. The material resembles maple sugar and is called *Huang t'ang* or yellow sugar by the natives. These baskets are shipped to market in this condition. Where boat carriage is to be used, the sugar is poured into wooden tubs about 3 ft. in diameter. Each batch of sugar makes a layer 2 to 3 in. thick. The different batches are separated by sheets of paper. Fig. 6 shows a set of pans used in a refinery to recover sugar from the sirup made up from dirty sweepings. The arrangement of the pans is shown in Fig. 7.

Nothing but scum is removed in the evaporating process. The imperfectly crystallized raw sugar is an important item of the internal trade of the province. A very large proportion goes into candy. The street vender with his little stove and iron plate is seen all over the province. He breaks up the plinths of *Huang t'ang* and melts them in the hot bowl. The molten sugar is dropped over bamboo sticks on the iron plate forming the Chinese youngster's lolly-pop—it is as popular in China as in this country and consumes a large part of the sugar supply.

## Refining the Raw Sugar

A considerable amount of the *Huang t'ang* is submitted to a refining process that gives a whiter sugar called *Beh t'ang* or white sugar. This industry is entirely separate from the process described and is nearly always carried on within the walls or just outside the walls of the large cities. Tze Chou and Nei Chiang are the cities in which most of the refining is carried on.

The raw sugar to be refined is placed in large earthen jars with bamboo sieve bottoms. A layer of clay mud about an inch thick is spread over the sugar and the jar set over a water jar. For about a month the jars are exposed to the air night and day. The moisture absorbed by the clay trickles down through the mass of sugar and leaches out the molasses, leaving a light brown granular sugar. The climate is very humid during the months that the refining is going on, so a considerable amount of water is absorbed. The light brown sugar is stored in bins until the spring months. It is then spread out on bamboo mats to dry and bleach in the sun. This sugar sells at twice the price of the raw material. Unless carefully handled, some of the mud from the top layer gets into the sugar and causes complaint. If too badly contaminated this dirty sugar is dissolved with all the sweepings and evaporated down at the refinery. Fig. 8 is a photo and Fig. 9 a cross-section of the refining jars.

The Chinese in the Tze Chou territory claim that 48 oz. of cane yields 8 oz. of the white sugar, *Beh t'ang*. This 16 per cent extraction yield looks almost too good considering the crude processes used, although the writer did not have means of checking this figure.

The molasses that collects in the lower jar of the set is called *Lou Tzu T'ang*. It is a black liquid and

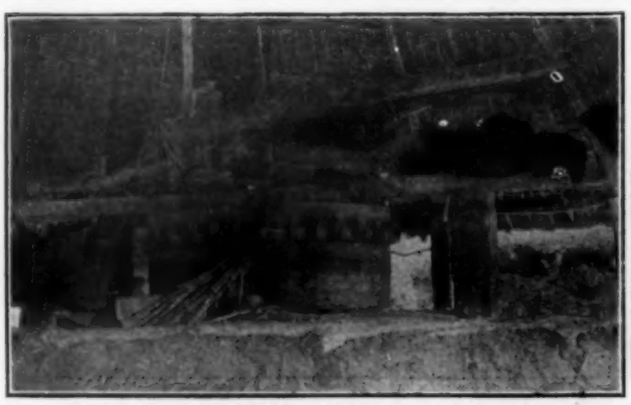


FIG. 4—STONE CRUSHING ROLLS HOUSED UNDER CONICAL THATCHED ROOF AT CHIENCHOU WORKS

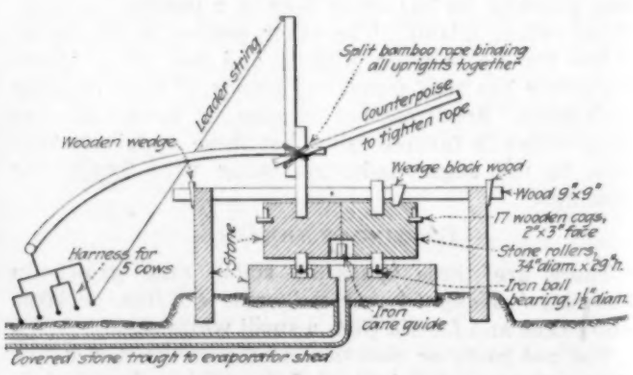



FIG. 5—CROSS-SECTION OF STONE CRUSHING ROLLS AT CHIENCHOU

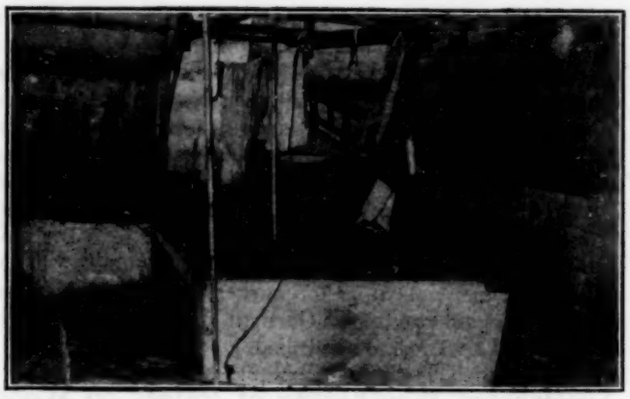


FIG. 6—EVAPORATING PANS IN REFINERY AT TZECHOW SZE, SHOWING TOOLS STORED IN PANS DURING SLACK PERIOD

is carried into nearby villages, where it is used as a sirup for rice cakes, diluted with water and used as a beverage in the fields or boiled up with popped rice—a variety of rice corresponding to our popcorn. This latter material is cut into slabs like our peanut bars and is a very popular confection.

### Uses of the White Sugar

White sugar is dissolved up in a minimum of water, placed in jars and the liquid permitted to evaporate naturally. The large crystals formed are called *Bin T'ang* and correspond to our rock candy. Those who wish the best sugar, free from grit, grind this sugar up in a mortar. It is also sold as a sweetmeat.

At the time of the festivals white sugar is melted up at street stalls and cast into molds. In this way hollow idols and animals are made, corresponding to our familiar hollow chocolate Easter bunnies.

In the sugar districts a large amount of the white sugar produced is consumed locally to preserve fruits and make the glacé ginger root so much in demand in this country. The dry preserved ginger root and wet comquots are familiar to all who have eaten in Chinese restaurants in this country, but there is scarcely a fruit or vegetable that is not sugar preserved in the Tze Chow district. Preserved peppers, apples and carrots are among the specialties of this section. A few years ago Tze Chow had eighteen shops that did a yearly business of about $150,000 and consumed about a tenth of the sugar refined in the town.

### Barley Sugar and Rice Sugar

The favorite candy of the Chinese adult is a white chewing candy called *Ma T'ang*. This very popular confection is made from a rice sugar which, on account of the method of its manufacture, is sometimes called barley sugar.

The manufacture of this sugar is essentially a home and small-shop industry. It is prepared by steeping 130 catties of dry rice in hot water and mixing the mash with 9 catties of barley sprouts which are produced by the germination of dry barley for 6 to 8 days in warm water. The mash is mixed in a covered tub with a sieve bottom which is placed over a pot of boiling water and steamed for 18 hours. The extracted material trickles down into the pot and is concentrated as the water evaporates. At the end of 18 hours the concentrated sirup weighs 80 to 100 catties. This sirup is boiled down and pulled to form a white candy.

The process is usually carried on "from supper to breakfast" according to the Chinese. This is from 3 p.m. to 9 a.m. During the night only a little attention is needed to keep the fire going. The yield is usually 3 lb. of heavy sirup to 4 lb. of rice. The material is very similar to the Japanese *Me Zu Amee* and is a delightful candy of much milder sweetness than cane sugar candy. On account of the nature of the industry no figures as to its extent can be given.

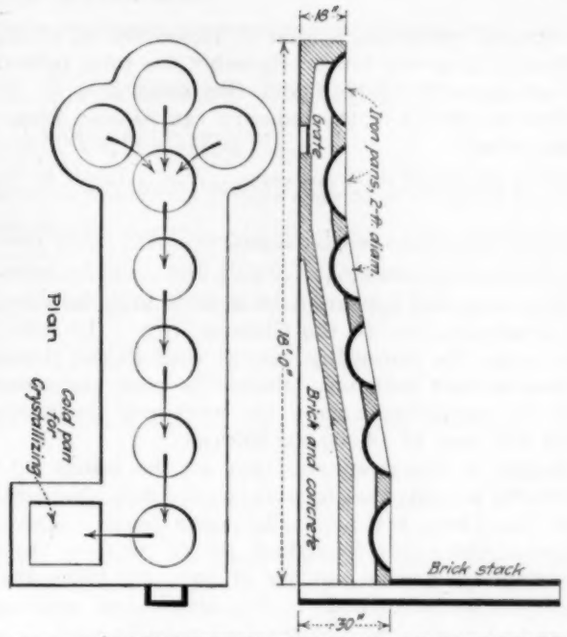



FIG. 7—CROSS-SECTION AND PLAN OF RAW JUICE EVAPORATOR AT CHIEN CHOU

FIG. 8—COMPLETE SUGAR REFINERY
Upper jar contains sugar covered with layer of mud

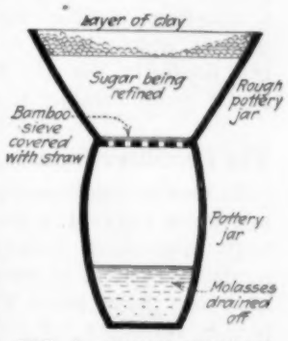



FIG. 9—CROSS-SECTION OF REFINING JARS

### Economics of the Industry

The raw cane sugar sells in the district at a little over 3 cents per pound. On the estimated production of 150,000,000 lb. per year, this means a business of $5,000,000.

It is difficult to tell how much sugar is refined. On one of our trips to Tze Chow a Chinese business man said there were twenty-seven refineries in the Hsien (township) that did a business of from 20,000 to 50,000 taels per year. For them all this would mean about $1,000,000 a year business, which at 6 to 7 cents

per pound represents a total of 15,000,000 lb. of sugar refined in this one town. Probably the total refined in the province would be double this amount.

The net extent of the industry can be seen from the table below:

| | | |
|---|---|---|
| Value of 150,000,000 lb. of raw sugar | (gold) | $5,000,000 |
| Value of 30,000,000 lb. of white sugar | | 2,000,000 |
| Total | | $7,000,000 |
| Value of raw sugar in refined sugar | | 1,000,000 |
| Net value of the industry | | $6,000,000 |

This may not appear to be a very large industry to an American, but to the Chinese with a 10 cent per day wage, the prevailing rate in west China, it means a considerable industry. Stated in cash, the common coin in circulation among the workmen, the business done per year is 18,000,000,000 cash.

Sugar is the dominant idea in the minds of the 3,000,000 persons that inhabit the district. Nei Chiang and Tze Chow are primarily sugar towns. The carriage of the sugar to distant points requires the employment of a large number of men, for there are no railroads or pack roads in the district, so coolie carriage and boats drawn by trackers must be used.

### Modernization of the Industry

Suggestions for the erection of a refining plant of 30 tons of pure white sugar per day for the year received favorable attention from the Chinese. The unsettled conditions brought about by the war have stopped all further plans on the subject. A modern plant of this size on a co-operative basis should be a good investment, for the Chinese like the foreign white sugar and would be willing to pay a premium for it. Loaf sugar sells in the Chinese stores by the piece as a sweetmeat at present.

On the other hand, a modern crushing and grinding plant would probably not be justified at present. The interest on the investment and the high cost of steam power could not compete with the abundant and cheap labor supply. However, technical conditions in the province and especially the district under review are ideal for a very large sugar industry. It will only be a question of time when the Chinese realize that a modern sugar industry in this section would obviate the necessity for their large present importation of sugar from foreign sources.

## The Fertilizer Industry and Market in South Africa

In *Commerce Reports* for June 12, 1922, Trade Commissioner Perry J. Stevenson of Johannesburg makes a very interesting résumé of the fertilizer situation in South Africa. The occasion for this is the completion of a very large plant with a capacity of about 100,000 tons of fertilizer per year by the DeBeers Company, the diamond producer. It has been estimated that the present consumption of fertilizer in South Africa is somewhat below the capacity of this plant, but this is due to the fact that South African farmers have not learned the lesson of intensive cultivation and consequently the yield per acre is much lower than in other parts of the world. Furthermore, the soil is becoming more and more impoverished each year.

In South Africa considerable fertilizer is imported from outside. In 1913 63,000 tons was brought in, but this fell during the war to as low as 16,000 in 1918. Some recuperation has been made so that in 1921 nearly 30,000 tons was imported. A large percentage of this was superphosphate, with miscellaneous manure fertilizers, basic slag and bone fertilizer making up the remainder. Great Britain, the Netherlands and Belgium in 1920 were the principal exporters to South Africa.

For the first time since the war German producers have reappeared in South Africa and the German Potash Syndicate has resumed operations through an agency in Cape Town. Superphosphates are being imported and several large shipments have been made. At the present time it is too early to estimate whether local producers can meet German and other competition, but a tariff may be invoked.

[1] "Report on the Province of Ssuch'uen," British blue book, China 5 (1904), 1909.

## Accelerated Weathering of Paints on Wood and Metal Surfaces*

By Harley A. Nelson
Research Laboratory, New Jersey Zinc Co.

The weathering of exposed surfaces involves variations of a cycle which includes light, temperature changes and moisture. Apparatus in which to artificially reproduce and observe the effects of these singly and combined has been constructed. Special 30-in. quartz mercury arcs furnish the source for ultra-violet (actinic) rays. The rate at which these deteriorate has been estimated with the means at hand. The useful rays appear to be in the region $\lambda = 3000$ Angstrom Units, or near the end of the sun's spectrum. Temperatures equal to summer heat on exposed surfaces—60 deg. C. (140 deg. F.)—are provided by the light. During the winter months advantage has been taken of low outdoor temperatures. Moisture, simulating heavy rainfall, is provided by a revolving spray. The pressure is maintained as high as practicable to promote erosion of decomposition products from the surface. An atomizer provides means for maintaining a saturated atmosphere.

Exposures are made at 28 in. from the light source. The panels are of selected white pine, or standard grade iron, 6 by 12 in., painted according to approved practice. For warm seasons, the cycle most used has been: light 24 hours (temperature 50 to 60 deg. C.), cooling, followed by moisture 24 hours (temperature 5 to 10 deg. C.). During cold weather 24-hour outdoor exposures have been added. Exposures have usually extended for periods of 60 to 90 days, with daily inspections.

Loss of gloss and formation of removable "chalk" follow in the order that these develop under normal outdoor exposure. Saturation of the film accelerates chalking under the ultra-violet light. Freezing saturated films promotes the formation of removable chalk. "Checking," developing gradually into deep cracking and fine scaling, has not been reproduced. Cracking has been reproduced to a limited extent by periodic exposures to low temperatures. Lack of adherence is evidenced by blistering and peeling when the saturated panels are exposed to the heat of the quartz mercury arc (50 to 60 deg. C.).

The relative susceptibilities of paints containing lithopone to light darkening are readily determined. The relative tendencies of tinted or colored paints to fade and discolor under light and moisture, are revealed by exposure.

The test has been applied to paints applied on metal surfaces with encouraging results.

*Summary of a paper presented before the twenty-fifth annual meeting of the American Society for Testing Materials, Atlantic City, June 26 to 30, 1922.

# The Technology of the Carbon Electrode Industry—I*
# The History of Its Development

**Beginning With Sir Humphry Davy's Experiments in 1800 with the Electric Arc, the Author Presents a Technical Description of the Evolution of the Electrode Industry and Briefly Reviews the Present-Day Applications of the Carbon Electrode in the Chemical and Metallurgical Industries**

BY CHARLES L. MANTELL
Division of Industrial Chemical Engineering, Pratt Institute, Brooklyn

IN WRITING the biography of a living man one of the first things to be mentioned is his age, for that gives an idea of the times in which he has lived and the experiences he has passed through. This, in a general way, is also true of an industry, for its age at least hints at the state of perfection to which it has been brought. To say that the manufacture of carbon electrodes on a commercial scale is but half a century old is therefore equivalent to calling attention to its phenomenal development.

It shall be the purpose of the present article to review briefly the technical history of this development, but before attempting this review it is perhaps desirable to direct attention to a condition which is peculiar to the carbon industries. While most industries have a more or less abundant literature, with numerous books, pamphlets and articles, the manufacture of carbon electrodes is a notable exception. Were it not to be considered sarcasm, the industry might even be referred to as a "black art," first because of the secrecy usually surrounding its processes, and second, because of the absolute physical dirtiness of the usual electrode plant. Carbon works have generally been regarded as fortications, through whose gates only the initiated might enter. Most of the manufacturers have been of the opinion that the less said on the subject the better for them. One reason for this, perhaps, is that in Europe the art of manufacturing high-grade electrodes was always regarded as a secret, of which only a few had definite knowledge.

## Early Experiments Lacking Commercial Significance

Sir Humphry Davy, in 1800, was probably the first to employ carbon electrodes in connection with the electric arc. His electrodes were made of charcoal, and were simply points or rods cut out of carbonized wood. As a result, they were neither dense nor homogeneous. It can easily be seen that such carbons were rapidly consumed, not especially surprising when we consider the current and voltage he used. He employed the great battery of the Royal Institution, constructed after Wollaston's design, consisting of 2,000 pairs of plates, from which he obtained an arc of approximately 4 in. in length. It is highly probable that if we were to take some of our modern electrodes and subject them to such an arc, they, too, would be quickly consumed, for oxidation of carbon at the temperature reached in the arc is very rapid.

Foucault was one of the first to make use of "deposited carbon," or the coke that condenses on the insides of gas retorts. As early as 1846, however, Staite and Edwards patented a process of making carbon electrodes from pulverized coke and sugar, the mixture first being molded under a high pressure, and later the shaped mass was baked at a white heat. The electrodes were then dipped in a concentrated sugar solution, the assumption being that the sugar would enter the pores and make the mass denser after a second baking. About the same time Leonolt prepared carbons consisting of two parts of retort coke, two parts of wood charcoal and one part of liquid tar. The materials were worked into a paste, well kneaded, molded, pressed, covered with sugar or sirup, and subjected to a high temperature for 30 hours or more. Leonolt also tried, but with indifferent success, to purify carbons by immersing them in different acids before baking.

In 1850 Watson and Slater experimented on a similar basis and 7 years later Lacassagne and Theirs attempted to purify electrodes by immersing them in fused caustic soda or potash, in the hope that they might thus change the silica in the carbons to soluble silicates. After fusing, the electrodes were steeped in hot water and exposed in a porcelain tube to a current of chlorine gas. It was supposed that the various earths not affected by the soda or potash would be converted into volatile or soluble chlorides, thus yielding a purer carbon.

Not long after these experiments, which were of no practical value, Curmer conceived the idea of making carbons of a mixture of lampblack, benzine and turpentine. This mass, after being kneaded, pressed and baked, left a porous coke, since the benzine and turpentine volatilized in a large measure during the baking process. Curmer attempted to increase the density of these electrodes by saturating them with resins and subjecting them to a second baking.

Jacquelain, formerly a chemist at the Ecole Central at Paris, made carbons by using the hydrocarbons obtained in the distillation of coals, turf, etc., and also from the products resulting from the carbonization of these materials in sealed vessels. He obtained fair results, but never worked out a practical method or attempted to engage in the industry commercially.

Gaudin worked on electrodes which he made of lampblack. At that time, however, the price of lampblack was so high that he was obliged to seek some other material. He heated resins, pitch, tars and oils in

*Editor's Note—This is the first of a series of six articles dealing with the technology of the carbon electrode industry. The subsequent articles will discuss raw materials; calcining and calciners; grinding, mixing, molding and extrusion; electric and gas-fired baking and furnaces; and cleaning, machining, testing and shipping.

closed vessels, and obtained sufficiently pure carbon upon their decomposition. The volatile products of these substances were condensed and collected to be used again in mixing. He proceeded by pulverizing the carbon left after the decomposition and mixed it with a certain percentage of lampblack, using the condensed volatile products as binding material. This mixture was well kneaded, and molded with steel molds under the pressure of a powerful hydraulic press. The electrodes, after being baked, were considered to be superior to those in commercial use at the time.

### The Beginnings of the Industry

From a commercial point of view, Carré appears to be the first to have had conspicuous success in producing carbons. He may justly be considered the founder of the industry.

The undeveloped state of electric lighting at the time had a great influence upon the work of these early investigators. It will be observed, however, that they were not far out of the way and that present-day practice differs from theirs only in that manufacture is assisted by more perfect mechanical methods.

When Carré studied the problem, the Gramme machine had just appeared and a host of inventors were struggling to construct a good arc lamp. There were demands for a good carbon that was practical in every respect, so that on the whole the time was very favorable to the founder of the arc-lamp carbon industry. It is interesting to read Carré's own account of this work:[1]

> The superiority of artificial carbons for various experiments and the possibility of purifying, with alkalis, acids, aqua regia, etc., the carbonaceous powders that enter into their composition led me to seek some means of producing them economically. By moistening the powders, either with sirups or gums, gelatine, etc., or with fixed oils thickened with resins, I succeeded in forming pastes sufficiently plastic and consistent to be forced into cylindrical rods through a drawplate placed at the bottom of a powerful compression apparatus of about 100 atmospheres. Carbons are now manufactured by this process and I have at various times presented some of them to the Société d'encouragement.[2]
>
> These carbons have three or four times the tenacity and are much more rigid than retort coke; cylinders of 10 mm. diameter and 50 cm. in length may be used without any danger of splintering during a break in the circuit. They may be as easily obtained in the slenderest diameters (2 mm.) as well as in the largest. Their chemical and physical homogeneity gives great steadiness to the arc, their cylindrical form, combined with the uniformity of their composition and structure, causes their cones to continue as perfectly shaped as if they had been turned in a lathe, and therefore there are no occultations of the point of maximum light like those produced by the projecting and comparatively cold corners of retort carbons. They are not liable to the inconvenience of flying into splinters when first lighted, as the others are, in consequence of the great and sudden expansion of the gas contained in their intercellular spaces which sometimes exceed 1 c.c. in capacity.

Carré's carbon mixture, which was patented Jan. 15, 1876, was as follows:

| | |
|---|---|
| Very pure coke, finely pulverized | 15 parts |
| Calcined lampblack | 5 parts |
| Sirup of sugar | 7 to 8 parts |

The whole mixture was well pounded together, kneaded and worked into a hard paste. It was afterward pressed through a drawplate by a hydraulic press and the carbons or rods piled into retorts, where they were baked at a high temperature.

The general operations in the manufacture of electrodes have remained practically the same for the last century. Thus Carré has described the crude beginnings of the industrial operations of calcining, grinding, mixing, shaping (either molding or extrusion) and baking. Improvements have been in every one of these, from the original crude coal-fired furnace with its low thermal efficiency and high fuel consumption, to the present highly efficient type of gas-fired continuous variety of multisection ring furnaces. It is a long step from the original calcining ovens, producing poorly shrunk coke to the gas-fired continuous vertical retorts used in the modern electrode plant.

In 1890 O. G. Pritchard[3], an Englishman, published a series of articles upon the manufacture of carbon electrodes. His raw materials and equipment are interesting to look back to, if for no other reason than that today, only 30 years or so later, they would not by any possibility be considered commercially feasible.

His raw material was foliated Ceylon graphite, which he purified by pulverizing to a fine powder and then treated with potassium chlorate and sulphuric acid. The sulphated and oxidized mass was further treated with sodium fluoride to get rid of silica as the volatile tetrafluoride. After calcination the material was ready for the use. Pritchard used purified cane sugar, caramelized, as a binder, explaining that he had failed in attempting to use tar oils, gums, hydrocarbons and beet sugar for the reason that all these substances produced undue porosity after the carbons were baked. He was unable to find a satisfactory measure for correcting this porosity.

Prichard's mixture was pressed through an orifice at the bottom of a vertical hydraulic press at a pressure of approximately 1,800 lb. per sq.in. The carbons were cut into the desired lengths by shears as the stream came out of the press. They were dried in an air-drying room and kilned in a very crude intermittent coal-fired furnace, much like those used at the present time for the small-scale manufacture of red brick.

### Early American Developments

In the United States there was a patent granted in 1858 to De Grasses B. Fowler of New York for the process of making carbon plates by mixing ground coke with tar, shaping the mixture under pressure in molds, packing the shaped material in lime and heating it slowly in an airtight box to drive off the volatile matter. As the experimental arc light shown at Yale in 1871 used electrodes cut from retort carbon, it is not very probable that Fowler's patent was commercialized for other than battery plates.

David Thompson of Newark was probably the first American manufacturer. His first plant consisted of a small crusher, a mixing pan, a crude brick oven, some cast-iron molds and a hand-operated grinding and bolting outfit.[4]

Charles F. Brush and Washington H. Lawrence of Cleveland began to experiment on the manufacture of carbon electrodes about 1877. As they had found other materials unsuitable, they investigated the use of petro-

[1] Carré, *Compt. rend.*, Feb. 19, 1877.

[2] Carré, *Bull.* de la Société d'encouragement pour l'industrie nationale, 1877. H. Fontaine, L'Eclairago Electrique," 1877.

[3] O. G. Pritchard, "The Manufacture of Electric Carbons for All Electrical Purposes," The Electrician Publishing Co., London, 1899.

[4] See p. 7 of "The Carbon Electrode," published in 1922 by the National Carbon Co., Inc., New York.

leum coke, a source of supply of which they found within a mile or so from their workshop where the Standard Oil Co. had for years burned it under the oil stills in an effort to get rid of it. At first they used the raw coke, pulverizing and molding it to shape in electrodes about half an inch square and a foot long. As these electrodes had an abnormal shrinkage after baking, Brush invented the process of calcination of the coke prior to its fabrication into an electrode. Brush also invented a hydraulic press to impart greater density (due to greater pressure applied during shaping) than was obtainable with the hand press which was first used.

By the year 1878 Brush was manufacturing electrodes on a commercial scale. It was electrodes such as these that Hall used in 1886 in his experiments which led to the commercial production of metallic aluminum.

### The Discovery of Artificial Graphite

The next important event was the discovery of the commercial manufacture of graphite. In 1893 in a lecture before the Société International des Electriciens, Girard and Street[3] of the Société "Le Carbone" described a furnace for the conversion of carbon into graphite. The method consisted in causing a series of arcs to play over the surface of the carbon to be converted. It was stated that an 85 per cent conversion was obtained. It is not known whether this method was ever commercialized.

In 1896 H. Y. Castner[4] patented a process for heating carbon electrodes by means of electricity so that "a graphite-like form of carbon was produced." It might be assumed that this anticipated Acheson's graphite electrode, were it not for the fact that Castner remarks that the resulting electrode "will be found to be of decreased density." The Acheson electrode, after conversion to graphite, has a higher density than its amorphous raw material. Castner also states "that the temperature produced is such that the carbon will give off the more flammable material it contains." Accordingly his patent merely covered the electrical baking of carbon electrodes.

In 1896 E. G. Acheson, then of the Carborundum Co., was granted a patent for the manufacture of graphite in an electric furnace. He heated carbon "in association with one or more oxides to a temperature sufficiently high to cause a chemical reaction between the constituents and then continued heating until the combined carbon separated out in the free state." He goes on in his patent to say: "It is not, however, limited to the use of oxides, as pure metals, their sulphides and other salts may be used; but for various reasons the oxides are to be preferred."

Three years after the patent was obtained the Acheson Graphite Co. was incorporated and started building a plant at Niagara Falls, which is now the center of the industry. The company proposed that several distinct forms of the product were to be produced. "One consists of forms or articles made out of amorphous carbon, with the desired amount of impurity added, which will afterward be heated in an electric furnace and converted more or less to graphite." Acheson had been doing this work for a year or more previous in the furnaces of the Carborundum Co. He had made about "200,000 carbon electrodes, measuring 15 in. in length, with about 1-in. cross-sectional area, for use in the Castner alkali process, nearly half of them having been shipped to Europe."[1]

To quote again from Acheson, writing in 1899: "It is not the present intention of the company to enter into the manufacture of their product into the finished form for the general market, but rather to encourage those now engaged in making the natural graphite into articles of commerce to become buyers of their material, substituting it for the natural product now used." He states that according to the company's plans, "they will erect machinery for reducing coke to grains of the desired size, an electric furnace through which the prepared grains will pass in a continuous stream, a pulverizer for reducing the grains as they are received from the furnace, and a scalping sieve through which the product from the pulverizer will pass, so that the particles exceeding 1/200 in. in diameter may be removed. The final flour will contain an amount of pure graphite proportional to the percentage in the original coke."

It is interesting that graphite was first shown to be an elementary body and an allotropic form of carbon in the first year of the nineteenth century and in the last year was made to order in great quantities and was rapidly becoming an article of commerce.

### Electric Furnace Electrodes

Up to the end of the nineteenth century practically all of the work in the carbon industry had in view the development of a satisfactory electrode for arc lighting. It was only in 1897 that Heroult and Hardmuth in France and Plania and Siemens in Germany started work on the development of suitable carbon electrodes for electric furnace work. They used anthracite coal for the first time as a raw material. Heroult manufactured electrodes in Canada in 1908 and in the United States in 1911.

A great deal of the credit for the development of the modern electric furnace electrode in the United States belongs to the National Carbon Co., which began, in 1906, experimental work to develop a furnace electrode several hundred times larger than the largest arc light carbon of that date.

The last quarter century has seen a most remarkable expansion in carbon electrode manufacture. Jehl[2] in 1899 lamented the fact that the center of the industry was at that time at Charlottenburg and Nürnberg in Germany, while there were so many other locations in the world with much greater natural advantages. He says: "There is no reason why England should not make high-grade carbons, why the United States, with its immense petroleum wells and natural gas spring, should not supply the world with all grades of carbons. Russia and other petroleum countries also have an advantage in starting carbon factories and supplying their own market; in fact, the whole carbon business seems to fraternize with the coal-gas manufacturers and petroleum distillers."

In the United States, in most instances, the industry has been dependent for its existence upon a source of cheap electric power for baking the electrodes, while in Europe the gas-fired furnace has been most generally

[1] *Bull.* des Société des Electriciens, vol. 12, p. 246.
[2] United States Patent 572,472, December, 1896.
[3] E. G. Acheson, "Graphite, Its Formation and Manufacture," *J. Frank. Inst.*, 1899, pp. 475-486.
[4] Francis Jehl, "The Manufacture of Electric Carbons for All Electrical Purposes," The Electrician Publishing Co., London, 1899.

used for baking purposes. In this connection, although not directly connected with electrode manufacture, the names of Mendheim of Munich for his invention of the gas ring and chamber furnace; Escherich, for his gas-ring furnace; and Meiser, for his modification of Mendheim's furnace, first applied to the baking of pottery and then adapted to the baking of electrodes, deserve prominent mention in the history of the electrode industry. The Meiser (more or less adapted to local conditions) modification of Mendheim's furnace is largely used in the United States. It has replaced electric baking to a large extent, even in localities where power is cheap.

Thus it may be seen that the development of the carbon electrode industry has been along four lines: (1) Electric arc lighting; as this industry expanded, carbon development attempted to keep pace with it. (2) Electrolytic manufacture—e.g., alkalis, chlorine, aluminum and magnesium. (3) Electrothermic work—e.g., calcium carbide, silicon carbide, graphite, etc. (4) Electric furnaces—e.g., electric steel; copper, brass and aluminum alloys, ferro-alloys; nitrogen fixation.

### Recent Development

One of the most important and useful industrial developments of recent years has been the extension of the use of electric furnaces. This was greatly accelerated by war conditions, war demands and war prices. This growth carried along with it an expansion of the electrode industry due to research and operating investigations. In 1919 there was a shortage of electric furnace carbons. Overwhelming demands swamped the manufacturers, not because of the lack of raw materials, but rather the inadequate manufacturing facilities.

The latest progress has been along the lines of much stricter specifications as to purity, resistivity, hardness and increased density of electrodes. The earlier workers tried to obtain higher densities by saturating the baked articles with binders and baking a second time. In the present day the end is reached by starting with higher density raw materials and calcining them in a manner which will increase this factor. One of the greatest plant problems of today is the maintenance of absolute uniformity of output.

The growth of the manufacture of carbon electrodes in the last 20 years or so has been tremendous. In 1899 the total value of electric furnace carbon output was $10,974,[9] in 1921 the total value of furnace electrodes produced was well over $10,000,000.[10] Electrode production is now the most important branch of the carbon industry; the output of brushes, which formerly was of greater significance only reached the value of $4,000,000 in 1921.[10] The following comments from a recent report of the Tariff Commission summarize the present status of the industry:

> The bulk of the production comes from the aluminum industry, which makes electrodes for its own use; and two carbon manufacturers, making chiefly graphite and amorphous electrodes respectively. Another large company was organized during the war to make amorphous electrodes. There are also a number of smaller concerns producing electrodes.
>
> The bulk of the production is from the states of Pennsylvania and West Virginia and from the Niagara Falls district of New York. The largest plant is probably one in New York.
>
> The entire demand in the United States can be supplied by domestic sources. The production at present probably exceeds the consumption.[10]
>
> The chief foreign producers are Germany, England and France. Carbon products are made in most of the countries of Europe and in Japan.

The essential rôle of the carbon electrode in industry and in modern life has recently been pointed out by Hinckley,[11] who has shown carbon electrodes enter into the manufacture of the following materials:

Electric steel, ferro-alloys, calcium carbide, silicon carbide and related abrasives; aluminum, calcium and magnesium metals; phosphorus and phosphoric acid; electrical resistance wire; titanium and zirconium; carbon disulphide; tungsten; fixed nitrogen (cyanamide); sodium; caustic soda and chlorine; and all of the electric furnace alloys. The electrode today is therefore an essential part of our modern existence.

*The second of this series of articles will discuss the raw materials for carbon electrode manufacture. It will appear in a subsequent issue of this magazine.*

[9] U. S. Census, 1900.

[10] U. S. Tariff Commission, 1921, Tariff Information Survey for Paragraphs 81 and 82 of Tariff Act of 1913.

[11] A. T. Hinckley, "The Development of the Modern Furnace Electrode," *Electrical World*, vol. 78, No. 26, pp. 1263-5; Dec. 24, 1921.

# Evaporation of a Liquid Into a Gas*

By W. K. Lewis

Head of Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

A LARGE amount of work has been done on the evaporation of water into air at temperatures below the boiling point. The dynamic equilibrium corresponding to the evaporation of water into air counterbalanced by the flow of heat from the air into the water is the basis of wet-bulb thermometry, the most useful method of determining the humidity of air. In 1886 Desmond Fitzgerald pointed out that the rate of evaporation of water into air is a fraction of the difference in partial pressure between the moisture in equilibrium with the evaporating water and the actual moisture content of the air in contact with it. It is true that Fitzgerald did not assume the rate of evaporation linearly proportional to this difference, but added a small correction term proportional to the square of the difference. Barrows and Babb made a large number of determinations of evaporation from the surface of Maine lakes and while their experimental determinations were subject to a large percentage variation, none the less their results substantiate this proportionality. More recently Willis H. Carrier has shown that the rate of water evaporation is, within experimental error, proportional to partial-pressure difference. The following is an analysis of the mechanism of such evaporation.

### Preliminary Assumptions

For purposes of formula derivation assume a long tunnel through which unsaturated air is flowing at constant mass velocity. The walls of this tunnel are non-conductors of heat. Along the bottom of the tunnel is placed a mat or wick permanently wet with water supplied from below as evaporation takes place above. The water is furnished to this wick at every point at a temperature exactly equal to that of the water on the upper surface of the wick at that point. There is no motion of the liquid water parallel to the axis of the tunnel. The mass velocity of the air over the water is constant and sufficiently low so that heat generated by friction may be neglected.

The unsaturated air entering this tunnel will become humidified in passing through it owing to the evapora-

*Abstracted from *Mechanical Engineering*, for July, 1922.

tion of water. In consequence, the temperature of the air will fall, and if the tunnel be sufficiently long, the water and air will ultimately come to equilibrium.

### Notation

In the formula to be derived, the following notation is used:

$A$ = Area of liquid in contact with gas.
$H$ = Absolute humidity of gas, or parts by weight of vapor per part by weight of vapor free gas.
$h$ = Surface coefficient of conductivity of heat between gas and liquid, or B.t.u. per unit time per unit surface area per unit temperature difference.
$k'$ = Coefficient of diffusion, or parts by weight of vapor diffused per unit time per unit area per unit absolute humidity difference.
$k$ = Coefficient of diffusion, or parts by weight of vapor diffused per unit time per unit area per unit vapor pressure difference.
$p$ = Partial pressure of vapor.
$P$ = Total pressure of vapor and vapor-free gas (i.e., barometer).
$\theta$ = Time.
$t$ = Temperature.
$r$ = Latent heat of vaporization.
$s$ = Humid heat, or number of heat units necessary to change the temperature of unit weight of vapor-free gas, *plus the vapor it contains*, 1 degree.
$W$ = Weight of liquid evaporated.

### Interaction of Water with Air

Now consider for the moment the conditions at any given point along the length of this tunnel. At this point the temperature, absolute humidity and pressure of water vapor in the air will be represented by $t$, $H$ and $p$. Since the apparatus is continuous in its operation these conditions will remain unchanged at this particular point, but will vary from point to point along the tunnel. The corresponding quantities representing the condition of the liquid water in contact with the air at this particular point are $t_w$, $H_w$ and $p_w$.

The mechanism of interaction of the water with the air is as follows: There exists over the water what is equivalent to a stationary film of air, which insulates the water from the main body of the air. Through this air film heat is diffused from the air into the water and through the same film there is diffusing, in the opposite direction, the water vapor formed by evaporation on the surface of the liquid. This evaporation cools the surface of water and, since it is available from no other source, heat must be supplied solely by diffusion from the air. The heat of vaporization must therefore be quantitatively compensated by the heat flow through the surface film and the rate of evaporation is limited by the rate of diffusion of vapor through the same film.

From the foregoing one can immediately write the following equations:

$$-\frac{dW}{Ad\theta} = k'(p_w - p) \qquad (1)$$

$$\frac{dQ}{Ad\theta} = h(t - t_w) \qquad (2)$$

$$dQ = -r_w dW \qquad (3)$$

Whence

$$p_w - p = \frac{h}{k'r_w}(t - t_w) \qquad (4)$$

This last equation is the one normally used for calculating the humidity of air from wet- and dry-bulb thermometer readings. In it, variation in $r_w$ is neglected and the term $h/k'r_w$ is assumed constant. For $p$ in millimeters of mercury and $t$ in deg. C., it equals 0.5. The equation implicitly assumes that the cooling of the air is differential—i.e., so small in the neighborhood of the point in question that the actual changes in temperature and humidity of the air, $t$ and $p$ (or $H$), are negligible.

Since

$$p = P\frac{\frac{H}{18}}{\frac{H}{18}+\frac{1}{29}} \qquad (5)$$

$$t - t_w = \frac{k'r_w}{h}P\left(\frac{\frac{H_w}{18}}{\frac{H_w}{18}+\frac{1}{29}} - \frac{\frac{H}{18}}{\frac{H}{18}+\frac{1}{29}}\right) \qquad (6)$$

Where $H$ is small, as is usually the case below 150 deg. F., $\frac{H_w}{18}$ and $\frac{H}{18}$ are negligible compared with $\frac{1}{29}$, and one may write, as a close approximation,

$$t - t_w = \frac{kr_w}{h}(H_w - H) \qquad (7)$$

where

$$k = 29k'\frac{P}{18}$$

It is obvious that $h$ and $k$ depend on the thickness of the air film and are therefore functions of the velocity of the air. It is, however, equally obvious that if air velocity be increased sufficiently to double the one, the other will double also. The ratio of $h/k$ therefore remains constant, independent of velocity. This explains why the reading of a wet-bulb thermometer is uninfluenced by the velocity of air passing it, provided the velocity is sufficient so that any heat lost by radiation is negligible in comparison with that picked up by conduction.

### The Relation $h/k = s$

Now consider the change in humidity and temperature of the air as it moves along the tunnel. Starting at the same point previously considered, the air will drop in temperature by an amount $dt$ and increase in humidity by an amount $dH$. The heat given up by cooling must correspond to the heat of vaporization of the water picked up—i.e.,

$$-sdt = r_w dH \qquad (8)$$

whence, assuming constancy of $s$ and $r_w$,

$$H = -\frac{s}{r_w}t + \text{const.} \qquad (9)$$

Assuming the tunnel indefinitely long, the air will ultimately become saturated at some temperature $t_e$, and humidity $H_e$. Since these conditions present equilibrium between the air and the water, evaporation will cease, and $t_e$ and $H_e$ are therefore the constant, fixed end-points of the process. Inserting these limits,

$$H_e - H = \frac{s}{r_w}(t - t_e).$$

We have now derived two formulas connecting $H$ and $t$, both applying to this same process of evaporation—i.e.,

$$H_e - H = \frac{s}{r_w}(t - t_e)$$

and

$$H_w - H = \frac{h}{kr_w}(t - t_w)$$

These two expressions must therefore be identical. By the method of undetermined coefficients this can be true only provided the corresponding coefficients are equal, i.e.,

$$\frac{s}{r_w} = \frac{h}{kr_w}, \text{ or } s = \frac{h}{k}$$

and $t_w = t_e$, a constant; and $H_w = H_e$, also constant.

So far the discussion has been limited to water and air. Obviously, however, the same relationships must apply to any liquid and any gas with which its vapor is mixed.

The first of these equations, $h/k = s$, states that the coefficient of heat transfer divided by the coefficient of vapor diffusion through the gas film is constant, and equal to the humid heat of the gas. By means of formula 4 the ratio $h/k$ can be calculated from the observed wet- and dry-bulb temperatures for any vapor-gas mixture of a known gas humidity. The experimental determinations of wet-bulb temperatures for water-air, water-carbon dioxide, toluene-air and chlorbenzene-air, and calculations for $h/k$ given in Table I show that

TABLE I—VALUES OF $h/k$ FOR VARIOUS VAPOR-GAS MIXTURES

| | $h/k$ Calculated From Experimental Results | Specific Heat of Gas |
|---|---|---|
| Water-air | 0.236 | 0.238 |
| Water-carbon dioxide | 0.217 | 0.220 |
| Toluene-air | 0.238 | 0.238 |
| Chlorbenzene-air | 0.248 | 0.238 |

this ratio is in all cases substantially equal to the humid heat of the entering gas, which in this case was identical with the specific heat because the gas which was used was vapor free.

We have therefore demonstrated that, granting substantial constancy of $s$ and $r_w$, and assuming $H$ to be small, the ratio of the coefficient of diffusion of heat to that of any vapor through the gas film on the surface of the liquid is equal to the "humid" heat of the gas. Furthermore, during adiabatic evaporation of a liquid into a gas, the liquid being in dynamic equilibrium with the gas, the temperature of the liquid remains unchanged throughout the process and the end-point of the process is reached when the gas has cooled itself to saturation at a temperature identical with that of an ordinary wet-bulb thermometer.

### Importance of the Relationship $h/k = s$

The importance of the relationship $h/k = s$ is very great. The term $s$, the humid heat, may be readily calculated for any case, regardless of whether the problem is primarily one of heat transfer or of diffusion. Hence if the heat-transfer coefficient $h$ has been experimentally determined for a certain type of apparatus operating under definite conditions, the coefficient of diffusion equals $h/s$, and the capacity of this same apparatus may be predicted when functioning in diffusion processes—e.g., as a gas scrubber. Conversely, if $k$ and $s$ are known for definite conditions, $h$ equals $ks$; in other words, one can predict the performance of a given apparatus for heat transfer from data upon the same equipment functioning as a scrubber.

These processes of diffusion of heat and of vapor are at the basis of the performance of all such equipment as humidifiers, dehumidifiers, water coolers, gas scrubbers, air driers, light oil stripping columns, and the like. The above relationships make it possible to study the performance of such equipment on a more rational basis than hitherto and to compare the effectiveness of different types of equipment even when the data on the individual types are obtained under widely varying conditions. The department of chemical engineering, Massachusetts Institute of Technology, expects to publish in the near future a series of articles showing various applications of these relations.

# Legal Notes

By Wellington Gustin

## Liability for Death of Trespassing Children in Poisoned Pool

By a divided court the decisions of the lower courts have been reversed by the United States Supreme Court in the case of Van Britt and wife against the United Zinc & Chemical Co. (264 Fed., 785.)

The chemical company owned a tract of about 20 acres in the outskirts of the town of Iola, Kan. Formerly it had there a plant for the making of sulphuric acid and zinc spelter. In 1910 it tore the buildings down, but left a basement and cellar, in which in July, 1916, water was accumulated, clear in appearance but in fact dangerously poisoned by sulphuric acid and zinc sulphate from the works of the company. The claimants had been traveling and encamped at some distance from the place. A traveled way passed about 100 ft. from the accumulated pool. Two children of claimants on July 27, 1916, went bathing in the water, were poisoned and died. Claimants brought suit for the deaths and at the trial the judge instructed the jury that if the water looked clear but in fact was poisonous and thus the children were allured to it, the chemical company was liable. The U. S. Circuit Court of Appeals affirmed a verdict and judgment against the company.

In reversing this judgment the Supreme Court has said that an owner of land owes to trespassers no duty to remove even hidden dangers, though he cannot prepare a trap for trespassers whom he expects to come upon his land. And infants have no greater right to trespass upon other people's land than adults, and landowners owe them no duty to expect them and to prepare for their safety.

Further this court says a land owner owes no duty to children to protect them from hidden dangers on his land, unless he has directly or impliedly invited them to come thereon, so that he is not liable for the death of the children in an abandoned basement, filled with poisoned water, which could not be seen from the highway and thus attract them.

The court's decision rests upon the question whether the poisoned pool of water could be seen from the highway or any place where the children lawfully were and that it was what led them to enter the land. Since there was no evidence to show such attraction the court held the chemical company owed them no duty, and therefore reversed the judgment. (42 S. C. Reporter, 299.)

### Dissenting Opinion Holds to Humane Doctrine

Chief Justice Taft and Justice Day concurred in a dissenting opinion written by Justice Clark. They pointed out that from 1873 until this decision the Supreme Court of the United States had applied, in

such cases as this at bar, what is termed the "humane" doctrine and deplores this change to the "hard doctrine," or the "Draconian doctrine." The "humane" doctrine was established by a decision of the U. S. Supreme Court in 1873 (Railroad Co. vs. Stout, 21 L. Ed., 745) in a unanimous decision. Since then the Supreme Court of Illinois, on authority of the Stout case, held a city liable for the death of a child drowned in a similar pool of water not poisoned. Justice Clark says:

"Believing as I do that the doctrine of the Stout and McDonald cases, giving weight to and making allowance, as they do, for the instincts and habitual conduct of children of tender years, is a sound doctrine, calculated to make men more reasonably considerate of the safety of the children of their neighbors, than will the harsh rule which makes trespassers of little children which the court is now substituting for it, I cannot share in setting aside the verdict of the jury in this case, approved by the judgments of two courts, upon what is plainly a disputed question of fact and in thereby overruling two decisions which have been accepted as leading authorities for half a century, and I therefore dissent from the judgment and opinion of this court."

## Sale of Parts for Unpatented Apparatus Used with Process Patent Not Infringement

The U. S. Circuit Court of Appeals has held that the sale of a single part for use in an unpatented apparatus for carrying out a patented process does not constitute contributory infringement of the process patent, in an action brought by the Electro Bleaching Gas Co. against William G. Miller and others. This holding has been upheld by the United States Supreme Court (42 Sup. Ct. 187).

The Electro company charged the defendants with contributing to the use and practice of the process of antisepticizing water, which rights it claimed under process patent No. 1,142,361, as granted to George Ornstein. The inventor originally applied for a patent on the apparatus as well as the process, but the request for the apparatus was rejected by the examiner of the Patent Office and withdrawn. The application upon which the letters patent were finally granted does not describe the apparatus in any of the claims but only the process of antisepticizing waters, although in the specifications the apparatus to be used is described and also illustrations of three kinds of apparatus which may be used are filed.

### Apparatus Sold by Plaintiff for Use With Process

The apparatus by which the patented process is made operative, as shown by the figures accompanying the application, comprised an absorption tower, through which the minor flow of water passes downward to absorb an upwardly moving current of chlorine gas. The chlorine is supplied from a tank of compressed and liquefied chlorine gas from which a pipe leads into the lower part of the tower. The tank is provided with a shut-off valve and the supply pipe with a pressure reducing valve and a regulating valve. Water is supplied to the tower from any suitable source.

The infringement charged is a chlorine gas-pressure regulator, performing the same office and producing the same results as the pressure reducing and regulating valves of plaintiff's apparatus. The company had sold to the city of Chicago, for use in its municipal water plants, a number of complete sets of its apparatus. Later the city purchased from defendants a Miller chlorine gas-pressure regulator to replace the corresponding part in the company's apparatus. The city made this change, according to its assistant city engineer, because defendants' valves enabled the city to obtain a better regulation of gas flow from defendant's valves and a great saving in maintenance costs. The city of Kansas City made a similar change and the city chemist in charge of water purification said the reason was that plaintiff's valve mechanism was insufficient in capacity to get the required quantity of gas into the coke-filled tower.

The U. S. District Judge held that the sales of these valves constituted infringement of plaintiff's process patent, which judgment has been reversed.

It was not claimed that defendants had employed the process of the patent in suit, nor that they had made or sold apparatus for employing that process. Only they sold the pressure regulating valves to replace regulator valves furnished as a part of the apparatus sold by the plaintiff company. Defendant's valves were manufactured and sold by them for general use and were used in some flour mills.

The real question in issue was whether upon this state of facts a person selling a single part for use in an apparatus employed in manufacturing an article protected by a process patent is guilty of contributory infringement.

### Distinction Between Process and Apparatus

The application for patent on the apparatus of Ornstein was denied by the Patent Office, and then abandoned by him. The Supreme Court has said: "A machine is a thing. A process is an act or a mode of acting. The one is visible to the eye—an object of perpetual observation. The other is a conception of the mind, seen only by its effects when being executed or performed." (Tilghman vs. Proctor, 102 U. S. 707). Again the Supreme Court, in Cochrane vs. Deener, 94 U. S. 780, said: "A process is a mode of treatment of certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing. . . . The machinery pointed out as suitable to perform the process may or may not be new or patentable; while the process may be altogether new, and produce an entirely new result. The process requires that certain things should be done with certain substances, and in a certain order; but the tools to be used in doing this may be of secondary consequence."

A process and an apparatus by which it is performed may be found in one patent, or they may be made the subject of different patents. And the court here points out that the valves sold by defendants in no wise affected the process, but at most the apparatus which was not protected by the patent.

A similar ruling was made by the Supreme Court in the case of Rumford Chemical Works vs. Hygienic Chemical Co., 30 Sup. Ct. 45. In another case it was of "the opinion that the line should be drawn to include those articles which are either parts of a patented combination or device or which are produced for the sole purpose of being so used and to exclude the staple articles of commerce." 207 U. S. 198.

Therefore the Court held that the defendants were not guilty of contributory infringement as alleged and the District Court was reversed.

# Cast Iron as Produced in the Electric Furnace, and Some of Its Problems*

**A Basic Electric Furnace Is Useful to Refine Cupola-Melted Iron, Reducing Sulphur and Gases to Any Extent Desired, and Producing Easily Machinable Castings, Very Tough and Strong, and With a Minimum of Defectives From Dirt or Blowholes**

By George K. Elliott
Chief Metallurgist, The Lunkenheimer Co., Cincinnati, Ohio

THE first use of the electric furnace for gray cast iron in everyday production, and not in sporadic experimental heats, seems to have been in the iron foundry of the Lunkenheimer Co. at Cincinnati in the summer of 1917. Beginning with "cold charge" heats, the process soon underwent a logical change into the duplexing process, wherein the cupola was utilized for the otherwise costly melting period of the cycle. The first few months the furnace, a Heroult with basic hearth, was confined to melting cold charges of special low-phosphorus iron, desulphurizing, reducing the carbon by dilution with steel, adjusting silicon to suit the size and nature of the castings, and finally casting into parts for which semi-steel originally had been used.

## Melting Cold Charges

This product perhaps came as near being the consummate semi-steel as is possible. This relatively expensive process soon developed into the tandem process and now is used only on rare occasions when small heats of special iron are desired. It is the writer's understanding that several foundries are using the cold-charge method regularly where tonnage is too small to justify a cupola and close control of an exceptional grade of iron is required. Under such combination of circumstances there seems to exist a limited economical field for the complete cycle of melting, refining and superheating in the electric furnace.

Several of these "cold charge" furnaces are operating with acid hearth, which means leaving from the cycle the element of refining except in a sense that is mild in comparison with the rigorous basic process. Properly conducted, this acid process consists of melting and superheating under conditions that at least are non-oxidizing as far as furnace atmosphere concerns. The length of stay in the furnace after being melted may become a period of purification, insomuch as an undisturbed exposure to a high temperature in a harmless atmosphere is likely to bring about a flotation on the bath of some of its non-metallic inclusions. Especially will high sulphur aided by manganese automatically reduce in this way to a measurable degree. Irons with 0.15 per cent sulphur have been known to decrease by as much as one-fourth or one-third through manganese sulphide floating to the surface.

The cold-charge process for cast iron probably never will acquire more than a scattered application, and the greatest possibilities seem to lie with the duplexing process. This is because the cupola cannot be relegated to disuse without working economic violence to the commercial foundry. The cupola delivers molten iron, with a minimum of care and labor, too cheaply to be discarded. Any melting scheme for the iron foundry must take into serious consideration the cupola furnace. It needs no substitute, but at times an adjunct is desirable; here is the opportunity for the electric furnace.

Since the duplexing process apportions refining to the electric furnace, the most logical hearth for the electric furnace is the most potently refining one—in other words, the basic hearth. In it lie the best and widest possibilities of the electric furnace for cast iron.

## Duplexing in Basic Hearth

Duplexing, as said before, probably was practiced first at the Cincinnati plant, and there also it has been used most continuously, while it was at a plant in Birmingham, Ala., that it developed its greatest tonnage, where a pipe foundry frequently passed over 200 tons of iron through the electric furnace in 24 hours.

"What are the conditions in the average iron foundry of today that make feasible the addition of an electric furnace to the equipment? This is a common question. In a sentence we can answer that the influencing factors are, (*a*) the limitations of the cupola, (*b*) the cost of available raw materials, and (*c*) a shifting of the basis of competition in a certain volume of the gray-iron castings business from price per pound to quality per piece. Any one of these may carry enough weight to swing the balances in favor of the electric furnace in some cases, while in others—by far the great majority—the united three cannot budge the foundry policy from its present established position. The electric furnace must not be taken up hastily and without a complete survey of its advantages and disadvantages, because in one field it may be an unmistakable success, while in another it will show only loss.

## Advantages of Cupola Melting

In speaking of the limitations of the cupola the writer must not be taken as unfriendly to it or in the least unappreciative of its many sterling virtues. It is without peer as an efficient, inexpensive, universally operated metallurgical servant for the production of molten iron. Probably no other furnace can melt similar metal at a fuel cost of 75c. or lower per ton, which is what the cupola does steadily and with approximate satisfaction on all counts. It lacks only some of the refinements of operation frequently demanded by modern conditions. These occasionally demanded improvements are an ability to reproduce uniformly any desired composition of iron, a positive ability to refine in addi-

*A paper presented at the forty-first general meeting of the American Electrochemical Society held in Baltimore, Md., April 27, 28 and 29, 1922.

tion to melting and an increased power to superheat. To accomplish refining the cupola is helpless, while it has decided restrictions when it comes to superheating.

Just as the inability to refine and superheat are outstanding weaknesses of the cupola, so is the corresponding ability to do them the great advantage of the electric furnace, especially the furnace with basic bottom. Such furnace is the pre-eminent refining furnace for iron and steel. Handling cast iron, it is capable of delivering without too great attention metal superheated to any degree, reduced in sulphur as required, deoxidized and with carbon, silicon and manganese adjusted to the desired standards. Phosphorus alone cannot be altered in cast iron by the electric furnace except by impracticable methods.

The electric furnace is at its best when coupled with a chemical laboratory in an intimate manner. By sampling the molten iron as soon as transferred from the cupola the laboratory can determine as many elements as desired, and the proper additions can be made before the metal is ready to pour, making possible the closest regulation of the composition. Especially is this valuable in regulating silicon and carbon, elements reflected in the machinability of the castings. The rapidly growing tendency in machine shops to introduce standardized rates of machining seems to be taking little or no heed of the fact that there are many kinds of cast iron and that more than one kind may come from one foundry in one cupola during one day.

Maintaining fixed rates of machining and high production cannot be divorced from a parallel preserving the fixed proper grade of iron in the castings. In order to keep uniformly a certain machinability, iron must not vary in composition over too wide a range, especially in silicon and carbon, and at times manganese. Not a few modern factories have installed ultra-modern castings-finishing methods without first co-ordinating in the proper way their metallurgical and mechanical operations. In such cases the results are likely to be either a sad falling down in production from what was so elaborately planned, or a sacrifice of highly desirable physical properties in the product in order to attain and preserve production. Planning production without first establishing the best grade of iron for the product has led to more than one manufacturing débâcle.

## Desulphurization

The most striking reaction taking place in the basic electric furnace is desulphurization; also it may become its most valuable. There is no gainsaying that there is a tendency toward higher sulphur in the world's scrap pile. This is not because the foundrymen are no longer afraid of it and are giving it free rein, but rather because it daily is becoming more difficult to hold it within bounds. The universal scrap pile is swollen with the grim harvest of the greatest of wars, and economy demands that it be worked over into usable implements fit for the pursuits of peace. The average of the sulphur is high, perhaps 0.15 per cent, and upon remelting in the cupola almost 0.03 per cent more is picked up with each remelt. The basic-hearth electric furnace seems created almost for this crisis. Elimination of sulphur by its means is one of the readiest of metallurgical operations. Cast iron of 0.18 per cent can be reduced to under 0.07 per cent in about 30 minutes, meaning the changing of relatively bad iron into good. Geographical considerations are strong here, and the foundry located in a region remote from the sources of good pig iron, and therefore having to rely upon the scrap pile of the neighborhood, may be in a logical position to consider seriously the basic-hearth electric furnace.

Illustrating this application of the furnace, there was described in 1920 a small unit on the Pacific coast in which a hand-fed, two-phase arc furnace was utilized for working up otherwise unusable iron scrap.[1] Tensile strengths of 40,000 to 45,000 lb. to the square inch were claimed for the iron.

## Sulphur Limits

The introduction of the basic-hearth electric furnace is largely responsible for the prominence that the subject of sulphur in cast iron, especially low sulphur as compared with high, has received in recent years. The time is approaching rapidly when the question of the real effect of various amounts of sulphur in cast iron must be systematically and authoritatively investigated. Something is needed to reconcile the apparently anomalous results with high- and low-sulphur irons that are reported from time to time by different foundrymen and metallurgists. Logical sponsors for such inquiry would seem to be either the American Society for Testing Materials or the American Foundrymen's Association, or a committee of the two organizations.

The conditions in cast iron that will conduce to the precipitation of sulphide, in particles of an optimum size and of an optimum degree of dispersion, so as to assist or at least not hinder the production of mechanical properties of a high order, is a subject about which we know practically nothing. In conducting a research along this line we can suggest a very promising means of attack in the recently announced slip interference theory of the hardening of metals by Jeffries and Archer,[2] which seems capable of a wide application to many of our metallurgical problems, including the one of sulphur in iron. The question of mechanical tests also is involved in the solution of the sulphur problem, and it seems advisable that increased attention be given to tests of a more dynamic nature than the customary transverse and tensile tests, because there is good reason for believing that tests of such nature will differentiate between irons that give nearly identical results under the mentioned static tests.

If an answer to the sulphur problem ever is found, it probably will be many-fold with different limits of sulphur for different kinds of castings. The writer has first-hand knowledge of one class of large castings that invariably are "dirty," to quote the foundryman, at an important machined point whenever sulphur reaches 0.10 per cent or over. Empirically in this one case the answer has been found; generally we can only surmise how far we dare go with sulphur.

To the writer it seems that the sulphur question is involved in the greater one of general refinement, and it is probable that iron high in sulphur also is endowed plenteously with other impurities, some of which may be almost entirely unknown. Examples are oxygen in various combinations, nitrogen as nitride and perhaps others even less familiar. The fact that an iron is desulphurized is evidenced that it has passed through a

[1] *Electrical World*, 1920, vol. 75, p. 265.
[2] "The Slip Interference Theory of the Hardening of Metals," Zay Jeffries and R. S. Archer, CHEM. & MET. ENG., 1921, vol. 24, p. 1057.

strong refining treatment, and the possibility that some of the benefits attributed to low sulphur in reality may be the result of the removal of one or more other impurities along with it has to be recognized. Desulphurization of iron means one of the most drastic cleansings known to metallurgy, and consequently low sulphur is becoming a hall-mark of refinement.

### Refining Reactions

Removal of sulphur requires a reducing slag, and this carries with it additional advantages to the iron. Broadly speaking, there are two inflexible requirements to be complied with before desulphurization can take place—a strongly basic slag and complete deoxidation of slag and bath. Without both there is no elimination of sulphur. The slag is made from an excess of lime, with fluorspar added for fusibility, and coke dust to produce the needed reducing conditions. Deoxidation of bath, since manganese, silicon and carbon all are present, perhaps is a somewhat complex reaction, but for simplicity we can assume the probable rôle of manganese as illustrative:

$$FeO + Mn = MnO + Fe$$

Being not as soluble in molten iron as FeO, the MnO rises to the surface to be taken up by the slag, where it is acted upon by the carbon and reduced back to metallic manganese, the carbon monoxide escaping. After the last of the oxide has been removed from the slag the first step toward desulphurization begins. Immediately around the electrodes where the greatest temperature prevails the carbon and the lime of the slag react, forming calcium carbide. This reaction is assurance that deoxidation is completed. Elimination of sulphur then proceeds by one or probably both of the following reactions (where Fe may act interchangeably with Mn):

$$MnS + CaO + C = Mn + CaS + CO$$

$$3MnS + 2CaO + CaC_2 = 3Mn + 3CaS + 2CO$$

The calcium sulphide formed in either reaction is insoluble in molten iron.

### Effect of Oxygen in Cast Iron

Deoxidation we have seen is a necessary concomitant of desulphurization, and cast iron coming from this process should be fairly free from oxides. This introduces one of the moot questions of cast iron. By some reputable authorities it is stoutly maintained that molten cast iron contains too much carbon, silicon and manganese to be able to carry iron oxide at the same time. Others declare it is entirely possible, and that its presence has certain tangible effects. As to the nature of the effects again there is a division of opinion. One group claims they are good, while another takes the opposite view, roundly condemning oxidized or "oxygenated" iron. The writer inclines to the belief that oxygen often persists in cast iron, in spite of the presence of oxidizable elements that should remove it, and also that its presence is undesirable. It seems to him that the persistence of oxygen as iron oxide in molten iron is as reasonably expected as is the well-known persistence of determinable amounts of sulphur and phosphorus in steel heats that have been put through the most rigorous and theoretically impeccable treatments for their removal. It is readily explained by the law of mass action, which enables the iron to hold to the last traces of these impurities.

That the influence of oxygen on the whole is bad is borne out by many experiences with the product of badly acting or carelessly operated cupolas. In these cases the iron without doubt was exposed to oxidizing conditions, and that it was materially affected thereby was shown in the sluggishness of the melt, which in spite of a high temperature prevented its running out castings solid enough to pass a porosity test. It appears probable that oxygen in some of its combinations, especially iron oxide, raises the freezing point of cast iron, bringing about a practical diminution of fluidity. One other point against iron oxide is its reaction with carbon, which is known to produce unsoundness in steel through the resultant gas, and there is reason to hold that this can happen also with cast iron. The time spent in the electric furnace during duplexing gives ample opportunity for this reaction to complete itself.

The oxygen question of cast iron is bound to remain unsettled as far as universal conviction is concerned, until analytical chemistry rises to the occasion. At present there is no generally accepted adequate method for determining all the oxygen in iron or steel. The Ledebur method is practiced here and there, but admittedly has serious limitations, it being claimed that it reaches at best only 75 per cent of the ferrous oxide that may be present,[3] while it misses entirely the oxides of manganese, silicon and titanium. Few contributions to metallurgy could at present be greater than a complete set of accurate practicable methods for determining oxygen and oxides in the various metals and alloys. Let those analytical chemists who feel that dull and futureless is their lot ponder this opportunity for making a well-nigh monumental contribution to practical metallurgy! In the same category we may also include nitrogen and other gaseous elements. The arc electric furnace, particularly the long-arc furnace, with its seeming possibilities for nitrogen fixation, makes pertinent the question of determining nitrogen readily and studying its effects upon iron and steel. There are the Allen method, and one or two others, for determining nitrogen, but they are attended by an uncertainty similar to that of the Ledebur oxygen method.[4]

We are forced to admit that chemical analyses as now made of metals and alloys often are only part analyses, and the elements that are eluding the analyst may be of paramount practical importance.

### Advantages of Superheat

In no other furnace can superheating be so effectively done as in the electric furnace. Either the acid or the basic furnace is a good superheater, but the former has some disadvantage in that too high superheat sometimes (depending considerably upon the quality of refractories) has a tendency to raise the silicon unduly. Several times the writer has seen as high as 3.80 per cent silicon in cast iron coming from an acid furnace that went in at barely 2 per cent. In the basic furnace the tendency is toward a slight reduction.

The advantages of superheating can all be summed up in the one word "fluidity." The electric furnace gives fluidity to irons not commonly considered fluid, a conspicuous example of which is low-phosphorus iron. This class of irons generally is preeminently strong, but

---

[3] Bureau of Standards Scientific Paper 346, by Cain and Pettijohn.

[4] Very recently (Chem. & Met. Eng., 1922, vol. 26, p. 218) there was published an iodide-iodate method by Hurum and Fay, that may be one of the needed long steps forward in the determination of nitrogen in steel; so far no mention has been made of its applicability to cast iron.

unsuited for castings needing fluidity. Superheating in the electric furnace can make many of these irons eligible for the thinnest of sections.

Fluidity is a strong assurance of solid castings through freedom from blow-holes, shrink holes, slag inclusions and the like. Superheated metal increases the effectiveness of risers by lengthening the period of fluidity, which is their only period of activity as feeders, and thereby obviates to a large degree that internal shrinkage that comes from fluid contraction of the metal. Abetted by superhot metal, the efficiency of the ordinary riser becomes surprising.

Blow-holes seem to be eliminated to a considerable extent by superheated metal acting through risers. The ferrostatic pressure of molten iron is nearly one-quarter of a pound per square inch for each inch of head. In any mold of ordinary dimensions this is not great enough to increase perceptibly the density of the metal itself, but it seems sufficient to prevent the release of dissolved gases from the metal and the consequent formation of blow-holes. In this way the pressure of fluid molten metal may be said to increase the actual density of the castings themselves by the elimination of blow-holes. This tendency of very fluid iron to prevent by pressure the liberation of dissolved gases perhaps is somewhat unnecessary in the cases of electric furnace irons that have been through sufficient refining to insure practical degasification.

### Carbon Oxides in Solution

In connection with the gases CO and $CO_2$ held by the metal in solution or otherwise, there was a significant paper read before the Iron and Steel Institute (British) in the autumn of 1920,[5] by Honda and Murakami, in which it was claimed that in pure iron-carbon alloys graphite is formed not as the direct result of the decomposition of cementite at high temperature according to the reaction, $Fe_3C = 3Fe + C$, but rather through the catalytic action of CO or $CO_2$. Should this hold true with impure alloys such as cast iron, the removal of these gases in the electric furnace might be expected to have a retarding effect upon the precipitation of graphite.

The present writer has seen some evidence to strengthen this theory, chief of which is an occasionally apparent capability of electric-furnace cast iron to carry higher silicon without perceptible opening of the grain, excessive graphitization and the consequent softening and loss of strength, than a similar iron is capable of that has not been refined. In other words, degasification in so far as the elimination of CO and $CO_2$ is concerned may explain a part of the increased strength and soundness of electric furnace cast iron, on the ground of its ability to discourage a headlong massive precipitation of graphite. It may be that this retarding influence modifies the form of the graphite as well as influencing finer and more advantageously dispersed particles. This is far from a settled matter and the main object in introducing the idea is to stimulate thought and perhaps point out a path for investigators to explore.

To conclude, it may be that the electric furnace never will acquire the widespread use for cast iron that its most enthusiastic friends predict and desire, yet the writer of this paper does not feel that its usefulness to the art of iron founding is to be measured solely by its number of installations. If it accomplishes nothing more than to inspire a new and fruitful interest in the many problems of cast iron, it may well be said to have been a generous benefactor to all branches of the art. Not only does the electric furnace open up new avenues for the production of cast iron but also new lines for thought and experiment, and who is the man to declare that this last is least in importance?

[5] Also see Chem. & Met. Eng., 1922, vol. 26, p. 180

# Distribution of Tar Recovery From Byproduct Coke-Oven Gas

By Frederick M. Washburn and George E. Muns

At the byproduct coke plant of the Wisconsin Steel Works, located at South Chicago, Ill., an investigation was made into the quantity and composition of the tar removed at various points along the path of the gas, resulting in the data given below.

The plant consists of two batteries, each of forty-four Wilputte ovens, together with complete direct type byproduct recovery apparatus. The gas is conducted by goosenecks from the top of the oven through a mushroom valve and into the collecting main. At the mushroom valve it meets a spray of flushing liquor, which prevents pitching of the valve seats. The gas is then drawn through the suction mains, where it is again

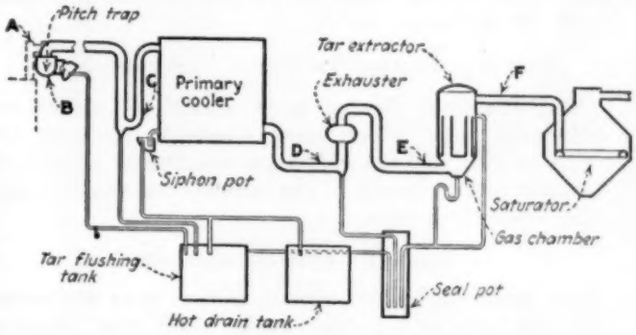



FIG. 1—GAS FLOW CHART

sprayed with flushing liquor, and conducted to the primary coolers, which are of standard indirect type, water-tube design. From this point it passes through Root positive exhausters, which force it through the tar extractor and other apparatus for the recovery of byproducts.

Fig. 1 shows diagrammatically the flow of gas from the ovens through the gas mains and apparatus, and the points at which condensed or extracted tar is drawn off for subsequent separation and storage. Temperature and pressure conditions at the points designated in the figure by the letters *A* to *F* are given in Table I.

TABLE I—TEMPERATURES AND PRESSURES THROUGH SYSTEM

| Readings at | Temperature Deg. C. | Pressure | Readings at | Temperature Deg. C. | Pressure |
|---|---|---|---|---|---|
| A | 346.0 | 3 mm. | D | 26.0 | —4.9 in. |
| B | 176.0 | 3 mm. | E | 36.1 | 63.7 in. |
| C | 79.5 | —3.1 in. | F | 35.5 | 55.8 in. |

All tests were run under uniform operating conditions, with temperatures and pressures normal, with an average net coking time of 22 hours, 51 minutes, and with a coal mixture of 95 per cent Benham (high-volatile) and 5 per cent Pocahontas (low-volatile) coal. Average tar and gas yields per ton of dry coal charged were taken over a period of 24 days operating at this

coking time, and amounted to 11.39 gal. of tar and 11.365 cu.ft. of gas. All figures in tar gallonage are calculated on a moisture-free basis because of the wide variation in moisture content of different tars separated.

The general plan of the test was actually to measure the tar recovered at the different points for a definite period of time, noting the total volume of gas handled during that time and obtaining a representative sample for analysis of the tar produced. Lack of tank space made the actual running time of the tests shorter than was expected, but good checks were obtained by repeating. In detail, the procedure was as follows:

### Test A. Tar Extractors

The hot drain tank was isolated and the tar separated by the P. & A.'s discharged this tank. Measurements were made at the start and finish of each run, and gallonage determined from the tank calibration and measurements. The sample for analysis was taken from the seal pot overflow.

### Test B. Gas Chamber (After Exhauster)

The gas chamber was emptied at the start. During the run the condensate was drained into tarred barrels at regular intervals, and at the finish of the run. The gallonage was determined from the weight and specific gravity of the tar. The sample for analysis was taken from the barrels.

### Test C. Exhauster Drain (Suction Side)

The exhauster drains were sealed off in 500-gal. cylindrical tubs, which were measured at start and finish of run, and the gallonage determined by calibration and measurements. The samples for analysis were taken from the tubs.

### Test D. Primary Coolers

The drains from the primary coolers were discharged into the isolated hot drain tank, which was measured at the start and finish of the run. The gallonage was determined by the tank measurements and calibration. The samples for analysis were taken at the siphon pot.

### Test E. Suction and Collecting Mains

This tar occurred in small quantities in comparatively large quantities of liquor and owing to the difficulty of measurement the amount of tar separated here was obtained by the difference between the previous tests and the total production. Separate samples for analysis were taken from the suction and collecting mains. In order to obtain an uncontaminated sample, an all-liquor flush was circulated for 4 hours before the test and during the test.

Moisture determinations were made on all samples except those from the suction and collecting mains. All samples were dehydrated, and specific gravity, free carbon and distillation determinations made on the dehydrated tars. The specific gravity determinations were made with a Westphal balance with the exception of the samples from the suction and collecting mains, which were too viscous for this method, so a tar specific gravity bottle was used. The distillations were made on a 100-c.c. sample in a 200-c.c. side-neck distillation flask connected to a vertical condenser.

The tar obtained from the exhauster drains (test C) probably represents separated tar mechanically carried over from the primary coolers, as from Table III

TABLE II—DISTRIBUTION OF TAR

| Test | Location | Duration of Run, Min. | Gas Passed, Thous. Cu.Ft. | Tar Obtained, Gal | Tar per Thous. Cu.Ft. of Gas, Gal. | Percentage of Total Tar Production |
|---|---|---|---|---|---|---|
| A | P. & A. tar extractor | 325 | 2,451.5 | 179.63 | 0.0732 | 7.30 |
| B | Gas chamber | 325 | 2,451.5 | 49.50 | 0.0202 | 2.01 |
| C | Exhauster | 325 | 2,451.5 | 433.26 | 0.1767 | 17.64 |
| D | Primary cooler | 120 | 867.5 | 354.96 | 0.4092 | 40.84 |
| E | Suction main | | | | | |
| F | Collecting main | ... | ..... | ..... | 0.3227 | 32.21 |

it may be seen that samples C and D are very similar in composition. Sample C is a slightly lighter tar than sample D, which would naturally follow, since sample D is composed of tar separated in all sections of the primary coolers, while sample C probably consists mainly of tar from the last or coldest section. From Table II it may then be seen that over 90 per cent of the tar present in the gas is removed during its passage through the mains and primary coolers. Two per cent of the remaining tar is removed by passage through the exhauster, leaving only a little over 7 per cent to be removed by the tar extractor. The free carbon and residues on samples E and F are extremely high due to coal dust mechanically carried over from the ovens. This coal dust is subsequently removed in a pitch trap. The tar from tests E and F are very heavy and viscous, since they were separated at a high temperature. As the separation temperature is lowered the tars become lighter and more fluid. Due to the increase in pressure and temperature caused by passage through the exhauster, a heavier tar is separated from the gas chamber (test B). Up to this point the separation of tar has been governed mainly by temperature and pres-

TABLE III—ANALYSIS OF TAR

| Test | Moisture | Sp. Gr. at 15.5 deg. C. | Free Carbon | Under 110 Deg. C | 110 to 170 Deg. | 170 to 235 Deg. | 235 to 270 Deg. | 270 to 300 Deg. | Residue and Loss |
|---|---|---|---|---|---|---|---|---|---|
| A | 4.45 | 1.135 | 4.21 | 1.5 | 6.0 | 39.5 | 9.5 | 6.5 | 37.0 |
| B | .47 | 1.140 | 3.45 | 1.0 | 3.0 | 30.0 | 10.5 | 5.5 | 50.0 |
| C | 6.50 | 1.121 | 3.44 | 1.5 | 5.5 | 33.0 | 10.0 | 8.0 | 42.0 |
| D | 5.60 | 1.140 | 3.48 | .5 | 5.0 | 35.5 | 11.0 | 6.0 | 42.0 |
| E | .... | 1.229 | 11.94 | ... | ... | 2.5 | 4.0 | 6.0 | 87.5 |
| F | .... | 1.202 | 10.92 | ... | ... | 5.0 | 6.0 | 7.0 | 82.0 |

sure conditions, but in the P. & A. tar extractor the temperature and pressure cease to play such an important part, for the mechanical action of the impingement of the gas on a surface caused the separation. The tar separated from the tar extractor (test A) represents practically the last traces of tar in the gas, and is the tar having the greatest percentage of oils and least pitch residue of any of the tars tested.

## Carbonization of Peat

Carbonization and gasification of peat are very fully discussed in a report of the Commission of Inquiry into the Resources and Industries of Ireland. This document which is available from the offices of the Commission, 87 Grafton Street, Dublin, for 2s. 9d., discusses very fully the resources of that country and the methods of development which have been tried. However, it is not by any means limited to the technology which has been utilized there, but gives a very complete analysis of the work done in all parts of the world.

In view of the comprehensive nature of this report it is not possible to do it justice in a brief review. Anyone interested in the subject of peat utilization will find it very desirable to secure a copy of the full document.

# Concentrating Dilute Nitric Acid Solutions*

**A Study of Rate of Concentration — Application of Results to Fractionation — Determination of Composition of Vapor Above Boiling Solution of Known Composition**

By Clifford D. Carpenter and Joseph Babor

THE PROBLEM of concentrating dilute solutions of nitric acid may be conveniently divided into two stages, preconcentrating and superconcentrating, *i.e.*, bringing the acid up to 50 or 60 per cent by simple fractionation and making acids of higher concentration which requires some special process.

This report will deal only with the problem of preconcentrating. Work is in progress on the problem of superconcentrating and the results will be reported at a later time. For our own convenience in describing our work and discussing the application of the results, we will divide the report into two parts. The first will give our results and discuss them in relation to concentrating the dilute acid by simple distillation and by fractionation.

## Part I

### Analytical Methods Used

In a recent article[1] we described a method by which we were able to distil a solution in such a manner as to prevent all errors introduced by fractionation and therefore study the rate of change in the concentration of the boiling solution while removing a vapor which was continuously in equilibrium with the boiling solution. While making more extended experiments we found ourselves in trouble on duplicating our results. We found our method of standardizing the base (succinic acid) was not easily duplicated so we tried the thallate and benzoic acid methods which checked each other but did not check the value given by the succinic acid method. We then secured from the Bureau of Standards a sample of benzoic acid with which the base used in these experiments was standardized. We have made a much more extended study of the problem using the experimental procedure described in our first article.

The Tables I to VI give the results obtained and Fig. 1 gives these results expressed graphically. The upper curve of Fig. 2 is a composite expression for the rate of change in the concentration of 1,000 grams of a 5 per cent acid from 5 to 68 per cent. The points

TABLE I—RATE OF CONCENTRATING OF NITRIC ACID FROM 3.342 TO 39.966 PER CENT.
Barometer 762.15 mm.

| Weight of Residue, Grams | Weight of Total Distillate, Grams | Weight of $HNO_3$ Distilled, Grams | Total Per Cent Distilled | Strength of Residue, Per Cent |
|---|---|---|---|---|
| 712.516 | 0.0 | 0.0 | 0.0 | 3.342 |
| 631.23 | 81.29 | 0.0275 | 11.41 | 3.768 |
| 554.10 | 158.42 | 0.0576 | 22.23 | 4.287 |
| 474.20 | 238.31 | 0.0907 | 33.45 | 5.002 |
| 391.90 | 320.62 | 0.1379 | 45.00 | 6.041 |
| 317.36 | 395.16 | 0.1953 | 55.46 | 7.442 |
| 245.29 | 467.23 | 0.2813 | 65.58 | 9.594 |
| 178.03 | 534.49 | 0.4240 | 75.02 | 13.101 |
| 131.69 | 580.83 | 0.6906 | 81.52 | 17.560 |
| 77.14 | 635.38 | 1.6730 | 89.18 | 28.700 |
| 50.72 | 661.79 | 3.5215 | 92.88 | 39.970 |

TABLE II—RATE OF CONCENTRATING NITRIC ACID FROM 11.727 TO 65.131 PER CENT
Barometer 0.756 mm.

| Weight of Residue, Grams | Weight of Total Distillate, Grams | Weight of $HNO_3$ Distilled, Grams | Total Per Cent Distilled | Strength of Residue, Per Cent |
|---|---|---|---|---|
| 545.802 | 0.0 | 0.0 | 0.0 | 11.727 |
| 493.66 | 52.14 | 0.211 | 9.55 | 12.92 |
| 444.26 | 101.54 | 0.439 | 18.60 | 14.31 |
| 386.69 | 159.11 | 0.764 | 29.15 | 16.35 |
| 327.09 | 218.71 | 1.236 | 40.07 | 19.19 |
| 266.19 | 279.60 | 2.050 | 51.23 | 23.28 |
| 211.25 | 334.55 | 3.441 | 61.30 | 28.67 |
| 164.97 | 380.83 | 5.803 | 69.77 | 35.28 |
| 117.114 | 428.69 | 11.298 | 78.54 | 45.01 |
| 64.315 | 481.49 | 26.424 | 88.22 | 58.44 |
| 33.48 | 512.32 | 42.169 | 93.87 | 65.13 |

TABLE III—RATE OF CONCENTRATING OF NITRIC ACID FROM 21.0775 TO 62.43 PER CENT.
Barometer 765 mm.

| Weight of Residue, Grams | Weight of Total Distillate, Grams | Weight of $HNO_3$ Distilled, Grams | Total Per Cent Distilled | Strength of Residue, Per Cent |
|---|---|---|---|---|
| 718.127 | 0.0 | 0.0 | 0.0 | 21.0775 |
| 657.62 | 60.51 | 0.93 | 8.43 | 23.35 |
| 588.10 | 130.03 | 2.34 | 18.11 | 25.34 |
| 514.32 | 203.81 | 4.52 | 28.38 | 28.56 |
| 443.15 | 274.98 | 7.60 | 38.29 | 32.44 |
| 357.82 | 360.31 | 14.30 | 50.18 | 38.30 |
| 270.94 | 447.18 | 27.33 | 62.27 | 45.77 |
| 187.17 | 530.96 | 49.26 | 73.95 | 54.55 |
| 105.26 | 612.86 | 85.65 | 85.32 | 62.43 |

TABLE IV—RATE OF CONCENTRATING NITRIC ACID FROM 34.239 TO 63.440 PER CENT
Barometer 766.7 mm.

| Weight of Residue, Grams | Weight of Total Distillate, Grams | Weight of $HNO_3$ Distilled, Grams | Total Per Cent Distilled | Strength of Residue, Per Cent |
|---|---|---|---|---|
| 728.196 | 0.0 | 0.0 | 0.0 | 34.239 |
| 649.74 | 78.46 | 6.357 | 10.77 | 37.43 |
| 562.85 | 165.35 | 16.14 | 22.71 | 41.47 |
| 476.80 | 251.39 | 30.06 | 34.52 | 46.03 |
| 385.36 | 342.84 | 51.73 | 47.19 | 51.33 |
| 302.76 | 425.44 | 79.25 | 58.43 | 56.25 |
| 216.10 | 512.10 | 117.80 | 70.31 | 60.96 |
| 165.07 | 563.13 | 144.83 | 79.13 | 63.44 |

TABLE V—RATE OF CONCENTRATING NITRIC ACID FROM 51.744 TO 66.934 PER CENT
Barometer 755 mm.

| Weight of Residue, Grams | Weight of Total Distillate, Grams | Weight of $HNO_3$ Distilled, Grams | Total Per Cent Distilled | Strength of Residue, Per Cent |
|---|---|---|---|---|
| 618.093 | 0.0 | 0.0 | 0.0 | 51.74 |
| 533.420 | 84.67 | 27.73 | 13.70 | 54.76 |
| 446.44 | 171.66 | 61.670 | 27.77 | 57.83 |
| 364.70 | 253.39 | 99.160 | 41.00 | 60.50 |
| 294.43 | 323.67 | 135.560 | 52.37 | 62.58 |
| 218.45 | 399.64 | 178.810 | 64.66 | 64.55 |
| 157.62 | 460.47 | 215.935 | 74.50 | 65.91 |
| 96.68 | 521.42 | 255.110 | 84.36 | 66.93 |

TABLE VI—RATE OF CONCENTRATING OF NITRIC ACID FROM 59.75 TO 67.16 PER CENT.
Barometer 758.00 mm.

| Weight of Residue, Grams | Weight of Total Distillate, Grams | Weight of $HNO_3$ Distilled, Grams | Total Per Cent Distilled | Strength of Residue, Per Cent |
|---|---|---|---|---|
| 584.87 | 0.0 | 0.0 | 0.0 | 59.75 |
| 537.20 | 47.67 | 23.11 | 8.15 | 60.75 |
| 480.94 | 103.93 | 51.61 | 17.77 | 61.94 |
| 475.86 | 109.01 | 54.28 | 18.64 | 62.04 |
| 417.08 | 167.79 | 86.06 | 28.69 | 63.16 |
| 350.59 | 234.28 | 124.22 | 40.06 | 64.26 |
| 296.38 | 288.49 | 156.48 | 49.33 | 65.13 |
| 244.87 | 340.00 | 188.23 | 58.13 | 65.86 |
| 184.95 | 399.92 | 226.52 | 68.38 | 66.49 |
| 122.32 | 462.55 | 267.48 | 79.08 | 67.05 |
| 89.51 | 495.36 | 289.38 | 84.70 | 67.16 |

*A paper presented before the Acid Symposium at the fourteenth semi-annual meeting of the American Institute of Chemical Engineers, Niagara Falls, Canada, June 19 to 22, 1922.

[1] *Chem. & Met. Eng.*, vol. 26, p. 443, March 8, 1922.

TABLE VII—VALUES CALCULATED FROM VALUES IN TABLES I TO VI BY WHICH THE POINTS ON THE COMPOSITE CURVES IN FIG. 2 ARE DEFINED

| From Table I | | | From Table II | | | From Table III | | | From Table IV | | | From Table V | | | From Table VI | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strength of Boiling Acid, Per Cent | Weight of Distillate, Grams | Weight of Acid In Distillate, Grams | Strength of Boiling Acid, Per Cent | Weight of Distillate, Grams | Weight of Acid In Distillate, Grams | Strength of Boiling Acid, Per Cent | Weight of Distillate, Grams | Weight of Acid In Distillate, Grams | Strength of Boiling Acid, Per Cent | Weight of Distillate, Grams | Weight of Acid In Distillate, Grams | Strength of Boiling Acid, Per Cent | Weight of Distillate, Grams | Weight of Acid In Distillate, Grams | Strength of Boiling Acid, Per Cent | Weight of Distillate, Grams | Weight of Acid In Distillate, Grams |
| 5.0 | 0.0 | 0.0 | 11.727 | 580.0 | 0.58 | 21.08 | 770.00 | 1.78 | 34.24 | 867.50 | 4.70 | 51.74 | 932.00 | 14.70 | 59.75 | 956.0 | 23.70 |
| 6.0 | 173.8 | 0.11 | 12.92 | 620.12 | 0.75 | 23.03 | 789.38 | 2.08 | 37.43 | 881.78 | 5.86 | 54.76 | 941.31 | 17.75 | 60.75 | 959.6 | 25.44 |
| 7.44 | 331.0 | 0.23 | 14.31 | 658.30 | 0.93 | 25.34 | 811.63 | 2.53 | 41.47 | 897.59 | 7.64 | 57.83 | 950.89 | 21.48 | 61.94 | 963.8 | 27.58 |
| 9.59 | 482.75 | 0.41 | 16.35 | 702.40 | 1.18 | 28.56 | 835.25 | 3.22 | 46.03 | 913.21 | 10.17 | 60.50 | 959.88 | 25.61 | 62.04 | 964.2 | 27.78 |
| 13.10 | 625.0 | 0.76 | 19.19 | 748.3 | 1.54 | 32.44 | 858.02 | 4.21 | 51.33 | 930.02 | 14.11 | 62.58 | 967.61 | 29.61 | 63.16 | 968.2 | 30.17 |
| 17.560 | 722.7 | 1.28 | 23.28 | 795.2 | 2.16 | 38.30 | 885.35 | 6.36 | 56.25 | 944.93 | 19.12 | 64.55 | 975.96 | 34.38 | 64.26 | 973.6 | 33.05 |
| 28.7 | 837.0 | 3.35 | 28.67 | 837.5 | 3.23 | 45.77 | 913.20 | 10.53 | 60.96 | 960.69 | 26.13 | 65.91 | 982.66 | 38.45 | 65.13 | 977.7 | 35.47 |
| 39.97 | 892.7 | 7.20 | 35.28 | 873.0 | 5.05 | 54.55 | 940.10 | 17.55 | 63.44 | 972.40 | 31.06 | 66.93 | 988.67 | 42.76 | 65.86 | 981.6 | 37.86 |
| | | | 45.01 | 909.8 | 9.28 | 62.43 | 966.10 | 29.18 | | | | | | | 66.49 | 986.1 | 40.70 |
| | | | 58.44 | 950.5 | 20.91 | | | | | | | | | | 67.05 | 990.8 | 43.82 |
| | | | 65.13 | 974.2 | 33.03 | | | | | | | | | | 67.16 | 993.3 | 45.47 |

which define this line are obtained from the results given in the six tables and are given in Table VII. The lower curve in Fig. 2 is a composite expression for the rate, in grams, at which the same acid escapes in the vapor while the concentration of the boiling acid changes from 5 to 68 per cent. If we read the points, in terms of the left-hand ordinate, at which the upper curve intersects the vertical lines representing the composition of the boiling solution we have the amount of distillate. If we read the points, in terms of the right-hand ordinate, at which the same line intersects the lower curve we have the amount of acid which is in the distillate. These points give the results in Table VIII.

An examination of Figs. 1 and 2 shows that very little acid is lost in the distillate until the concentration of the boiling solution reaches 20 per cent (1.6 g. acid to 759 g. distillate). The rate of loss increases slowly until about 30 per cent (2.4 g. acid to 809 g. distillate) when the rate becomes much greater but remains

TABLE VIII—INTERPRETATION OF FIG. 2.

| Change in Composition of Boiling Solution from 5 per cent to | Grams of Distillate | Grams Acid In Distillate | Change in Composition of Boiling Solution from 5 per cent to | Grams of Distillate | Grams Acid In Distillate |
|---|---|---|---|---|---|
| 10 per cent | 505.0 | 0.5 | 40 per cent | 892.5 | 7.07 |
| 15 per cent | 670.0 | 0.95 | 45 per cent | 910.0 | 9.75 |
| 20 per cent | 758.0 | 1.60 | 50 per cent | 926.5 | 13.25 |
| 25 per cent | 810.0 | 2.40 | 55 per cent | 941.3 | 17.75 |
| 30 per cent | 845.0 | 3.55 | 60 per cent | 956.7 | 24.10 |
| 35 per cent | 871.5 | 5.05 | 65 per cent | 977.0 | 35.20 |

rather regular until about 55 per cent when it again begins to increase more rapidly. At 63 or 64 per cent there seems to be a striking change and the concentration of the vapor approaches that of the residue very rapidly. It is possible that the peculiar inflexion in the curve between 63 and 64 per cent can be accounted for by assuming the presence of $2(H_2O)HNO_3$. The curve shows that the rate of change is regular enough to permit efficient fractionation up to a 55 or 60 per cent acid.

Galle[3] recently studied the preconcentration of nitric acid by using a flask to which was sealed a fractionating column and as a result of his experiments advises

[3] *Z. Angew. Chem.*, 1921, vol. 34, pp. 168 to 170; 173 to 175.

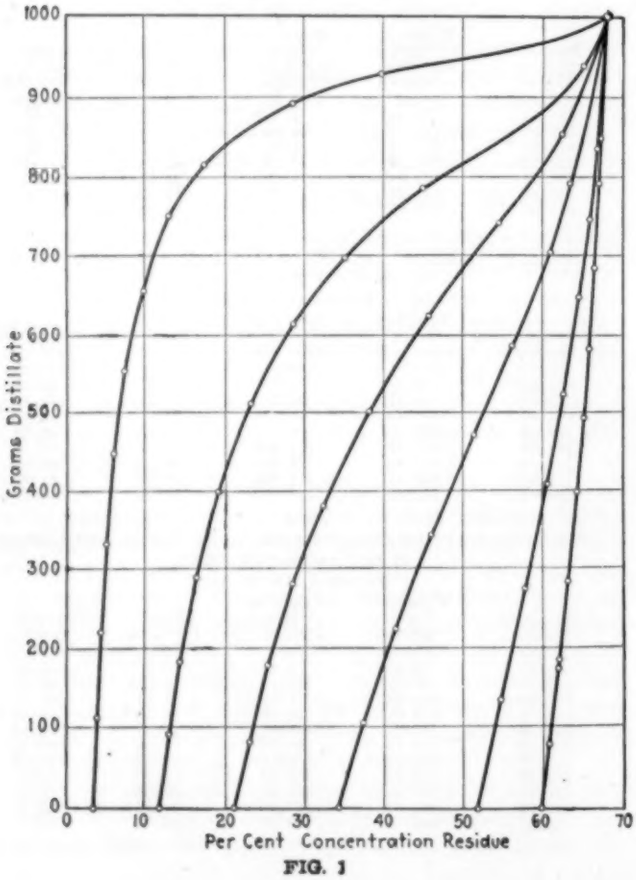



FIG. 1

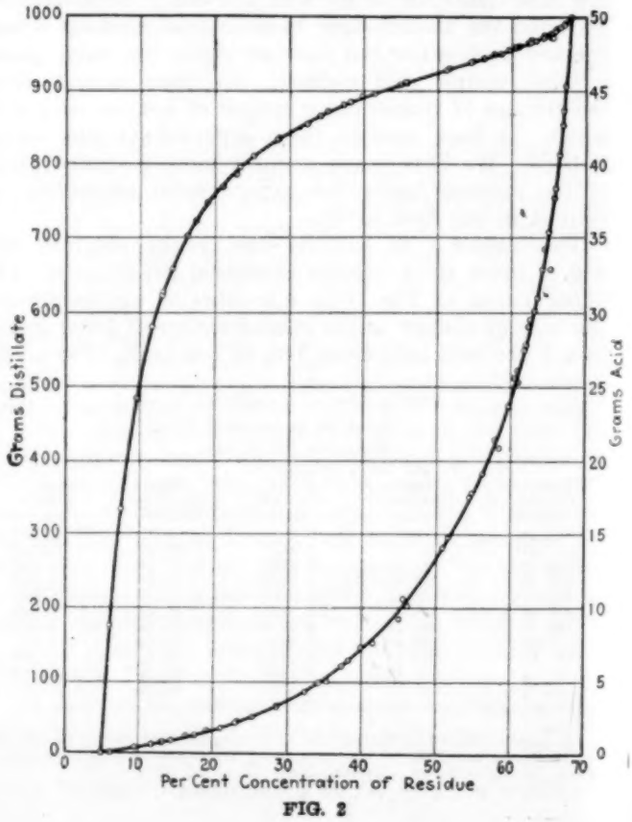



FIG. 2

the fractionation of dilute acid solutions up to 65 per cent before employing methods for superconcentrating the acid. It is evident however that the efficiency of fractionation will be much less above a 55 to 60 per cent composition.

If we wish to obtain a 55 per cent acid from 1,000 g. of a 20 per cent acid by simple distillation, the first residue will be 242.6 g., containing 133.4 g. of the original 200 g. of acid. The first distillate of 757.4 g. will contain the other 66.6 g. of acid and will have a composition of about 8.8 per cent acid. A distillation of the first distillate will produce 78.7 g. of a 55 per cent acid containing 43.3 g. of acid and give a second distillate of 678.7 g. with a composition of about 3.4 per cent. This means by two distillations requiring the vaporization of 1,336 g. of dilute acid that 321.3 g. of 55 per cent acid can be obtained from 1,000 g. of 20 per cent acid, a recovery of about 177 g. or nearly 90 per cent of the 200 g. of acid in the original 20 per cent solution. If a third distillation is made, about 15 g. more of acid may be recovered as 55 per cent acid and about 650 g. of 1 per cent distillate removed. This means that in three fractionations requiring the vaporization of about 1,985 g. of dilute acid that about 92 per cent of the original acid may be recovered as 55 per cent acid.

If it were desired to obtain a 65 per cent acid from the 20 per cent acid, the first distillate removed would be 905 g. containing 138.25 g. of acid while there would remain 95 g. of 65 per cent acid. The second distillation would begin with 905 g. of little more than 15 per cent acid and would require the removal of 840 g. of distillate leaving 65 g. more of 65 per cent acid. Two distillations of a 20 per cent acid will give 160 g. of 65 per cent acid by vaporizing, 1,745 g. of dilute acid. This means a recovery of 104 g. of the original 200 g. of acid. In order to recover 90 per cent of the acid from a 20 per cent solution as 65 per cent acid many fractionations would be required.

From our data it becomes a simple matter to calculate the number of fractionations required to recover nitric acid from dilute solutions at a higher concentration.

## Part II

### Composition of the Vapor

If we take the curves given in Figs. 1 and 2 and plot them on large co-ordinate paper it will be quite easy to read the amount of distillate and the amount of acid in the distillate while the strength of the acid changes one per cent from any desired concentration to the next higher. Knowing from the data given in Tables I to VI the rate at which the distillate is increasing, a very close estimate can be made for the composition of the vapor of the boiling solution at a concentration represented by the mean composition. Such calculations have been made by reading the values from the curves and the results are given in columns headed C and B in Table IX and have been used to define the curve given in Fig. 4.

Recently Pascal[3] and Berl and Samtleben[4] have carried out experiments in order to determine the composition of vapor above a boiling solution of nitric acid of known concentration. Both used an air bath heated by means of a bunsen burner. They inclosed the flask containing the boiling liquid in the air bath in order to prevent condensation in the upper part of the flask and delivery tube. Fig. 3, a, gives a sketch of our apparatus, described in our recent paper,[1] and the ones used by those referred to above. In the case of Pascal, Fig. 3, b, two thermometers are suspended, while Berl and Samtleben, Fig. 3, c, used only one. We have left out the thermometer as it would act as a fractionation column. The only way in which heat can be transmitted to it is by conductance from the boiling liquid and through the vapor. This fractionating effect would be very small in the more dilute solutions but as the concentration increases such an error becomes more serious, especially at the points where the change is most rapid. In our method it would be very serious for any such error becomes cumulative. If, however, it is only desired to know the composition of a vapor above a boiling acid, the error due to fractionation on a thermometer could be made negligible compared with the experimental accuracy possible by taking a small fraction from a large amount of boiling acid. Berl and Samtleben did this and their results are given in the second column in Table IX and are indicated in Fig. 4 by circles to which are attached small arrows. Those falling directly on our curve are indicated by two arrows and those falling to one side by one arrow pointing in the direction indicating the side upon which the point falls. They have made a slight error in their

TABLE IX—COMPARISON OF VALUES GIVEN FOR THE VAPOR COMPOSITION ABOVE BOILING NITRIC ACID SOLUTION.

| | Strength of Vapor | | | | Strength of Vapor | | |
|---|---|---|---|---|---|---|---|
| Strength of Acid | Carpenter and Babor | Berl and Samtleben | Pascal | Strength of Acid | Carpenter and Babor | Berl and Samtleben | Pascal |
| 5.00 | 0.048 | ..... | ..... | 45.00 | 18.00 | ..... | ..... |
| 10.00 | 0.200 | ..... | ..... | 47.50 | 22.20 | ..... | ..... |
| 12.50 | 0.35 | ..... | ..... | 47.77 | ..... | 21.71 | ..... |
| 13.45 | ..... | 0.46 | ..... | 49.80 | ..... | ..... | 19.85 |
| 15.00 | 0.55 | ..... | ..... | 50.00 | 26.50 | ..... | ..... |
| 17.50 | 0.75 | ..... | ..... | 52.50 | 31.10 | ..... | ..... |
| 20.00 | 1.05 | ..... | ..... | 53.96 | ..... | 33.51 | ..... |
| 20.58 | ..... | 1.26 | ..... | 55.00 | 35.50 | ..... | ..... |
| 22.50 | 1.45 | ..... | ..... | 56.60 | ..... | 39.37 | ..... |
| 24.20 | ..... | ..... | 2.16 | 57.50 | 41.70 | ..... | ..... |
| 25.00 | 2.20 | ..... | ..... | 60.00 | 47.80 | ..... | 50.02 |
| 27.50 | 3.00 | ..... | ..... | 61.47 | ..... | 51.34 | ..... |
| 30.00 | 4.10 | ..... | ..... | 62.50 | 54.60 | ..... | ..... |
| 31.75 | ..... | 4.94 | ..... | 62.64 | ..... | 54.46 | ..... |
| 32.50 | 5.60 | ..... | ..... | 65.00 | 60.80 | ..... | ..... |
| 33.00 | ..... | ..... | 5.90 | 65.18 | ..... | 60.62 | ..... |
| 35.00 | 7.30 | ..... | ..... | 67.43 | ..... | 65.97 | ..... |
| 37.50 | 9.40 | ..... | ..... | 67.10 | 66.80 | ..... | ..... |
| 37.99 | ..... | 9.20 | ..... | 67.89 | ..... | 67.84 | ..... |
| 40.00 | 12.00 | ..... | ..... | 68.00 | (68.00) | 68.00 | ..... |
| 42.50 | 14.90 | ..... | ..... | 68.40 | ..... | ..... | 68.40 |
| 43.50 | ..... | 14.86 | ..... | | | | |

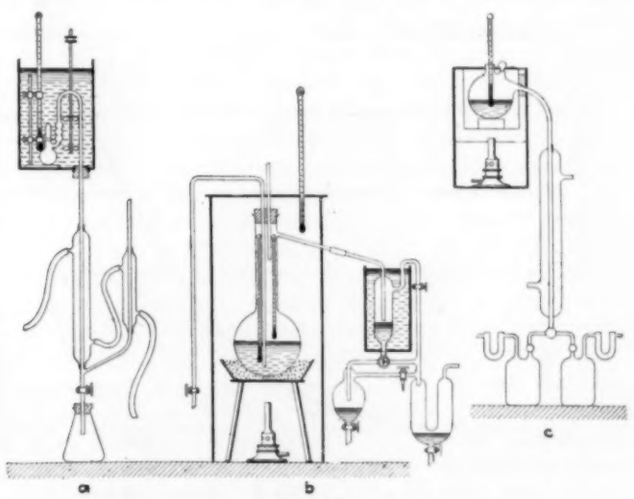



FIG. 3

[3] *Ann. chim.*, 1921. New series, vol. 15, pp. 253 to 290.
[4] *Z. Angew. Chem.*, 1922, vol. 35, p. 201.

estimation of the composition of the vapor, however, for they assume the concentration of the distillate to be the composition of the vapor above a boiling acid which is the mean between the composition of the boiling acid at the beginning and at the end of the change which takes place while the distillate is being collected. It is evident from the shape of the curve in Fig. 2 that this could only be approximately true for the lower concentrations of acids. They have partly corrected the error in this assumption by taking small fractions in the higher concentrations which of course results in a larger experimental error in determining the amount of acid in a small fraction.

Take for example their values obtained for 31.75 per cent (obtained by assuming the concentration of the distillate, 4.94 per cent, while the boiling acid changes from 30.22 per cent to 33.28 per cent to be the composition of the vapor of the mean concentration 31.75 per cent); for 37.99 per cent (residue changing from 37.13 to 38.85 per cent, the distillate of which was 9.20 per cent acid); for 43.50 per cent (residue changing from 42.73 to 44.27 per cent, the distillate of which was 14.86 per cent) and for 47.77 per cent (residue changing from 45.57 to 49.96 per cent, the distillate of which was 21.71 per cent), and note their position in Fig. 4. These values all fall to the right of the curve for in this range the concentration is changing rapidly and the composition of the distillate represents the composition of the vapor for a lower concentration of boiling acid than obtained by taking a mean value. While the values are in close agreement with those given by us, most of the points fall to the right of our curve as would be expected.

Pascal has given the values obtained for five points and are given in column headed P in Table IX and indicated in Fig. 4 by small squares.

### Conclusion

1. All values given in our first paper have been redetermined.

2. A brief discussion of the use of our results in considering the problem of fractional distillation has been given.

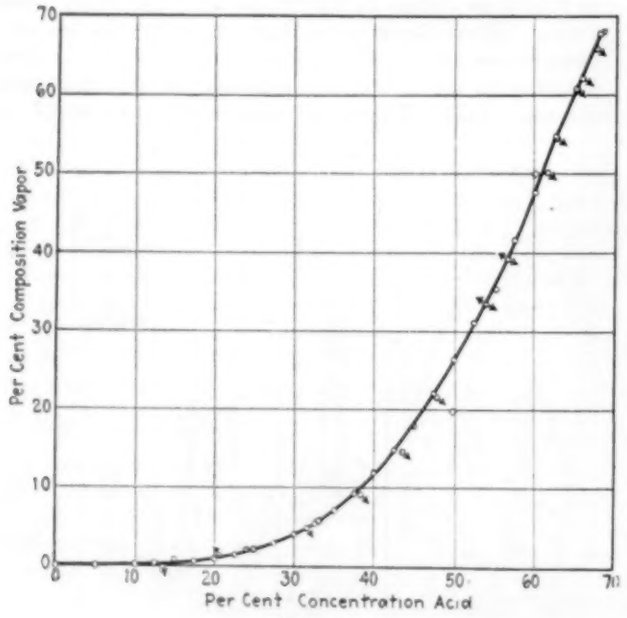



FIG. 4

3. The composition of the vapor above a boiling nitric acid solution from 5 per cent to 68 per cent composition has been determined.

4. A comparison has been made between our results and those obtained by Berl and Samtleben and by Pascal, and errors in their methods have been indicated.

5. When the rate at which the distillate is removed while the change in the concentration of a boiling acid solution is known it becomes a very simple matter to calculate the amount of distillate necessary to be removed by successive distillations in order to recover any desired amount of the acid at a higher concentration.

## Italian Oil Activities

An indication of Italian interest in the exploration of the country's oil resources is reported by Consul Leon Dominian from Rome. The Minister of the Department of Agriculture recently made a visit to the oil fields of Ripi and San Giovanni Incarico along the boundary between the Provinces of Rome and Caserta. (Government mining bureaus in Italy are under the administrative jurisdiction of the Department of Agriculture.) According to press reports of the event the Minister assured the managers of the local exploration plants that they could rely on Government help in their work.

It appears that one of the plans of the mining department of the Ministry of Agriculture is to subdivide the Kingdom into zones, in each of which it is proposed to station a Government oil expert. It is also proposed that the State purchase drilling plants specially adapted to deep boring, and that practical instruction in drilling be given to young mechanics prior to their employment by private concerns.

The region visited by the Minister of Agriculture is the seat of several exploration borings, two of which have already yielded oil. The depth at which oil has been found in that region varies between 147 and 240 meters (482 and 787 feet) and the total quantity of oil extracted amounts to 2 tons daily. It is proposed to carry on two sets of operations in the region for the purpose of tapping simultaneously the oil lying at shallow and excessive depths.

Another event which shows that attention is being paid by Italians to their native oil resources was the series of meetings of oil experts in Rome, beginning June 2, to discuss methods of increasing Italian oil production, particularly with reference to deep-seated oil resources. The experts recommended that oil explorations be conducted at great distance from one another in order that better knowledge of the country's possibilities be obtained, and that the Government should make a distinction between assistance to be granted to productive and unexplored regions. It was recommended that subsidies granted to productive zones should be confined only to exploration carried on beyond a depth of 600 meters in order that the deep-seated reserves, which are believed to be large, be tapped. Such subsidies are known as "premiums" in Italy and it is proposed to grant them on the basis of meters in depth.

Final recommendations were that capital intended for exploration work be exempt from all taxation, that no tax be imposed on the sales of native oil and that machinery imported from abroad for exploration work be allowed to enter Italy free of duty.

# Petroleum Education

**The Industry's Exacting Requirements of the Chemists and Chemical Engineers Are Carefully Analyzed and an Attempt Is Made to Outline Specialized Courses Most Likely to Yield Graduates With Proper Training and Preparation***

By Edwin DeBarr and Fred W. Padgett
University of Oklahoma

THE petroleum industry is one of very broad scope, involving various applications of physics, chemistry, geology, engineering and economics. The sequence of events has been concisely described as follows: The oil well is located by the aid of geology, drilled by the aid of profanity, the oil recovered and transported by the aid of mechanics, refined by the aid of chemistry, and the products are turned over to the shipping clerk. Those experienced in the oil business insist that the above description is mild and inadequate, especially in regard to drilling the well.

The petroleum geological engineer and the geologist are both primarily concerned with the problems of exploration and production. They investigate new areas for possibilities of production and are generally able to indicate whether or not the region is favorable for the accumulation of oil and gas. To the geological profession must go the credit for the discovery of quite a number of entirely new producing areas. Some time in the future, however, most of the exploratory work will have been completed, and the question arises as to whether or not geology will still bear its important relation to the industry. When this time comes, the petroleum geological engineer and the mining engineer will study in much more detail the structure and character of the producing formations and will focus their efforts on the problems of recovering the enormous quantities of oil which remain in the producing formations after they are considered to be exhausted. The results achieved in that field will probably be just as startling as those obtained during the period when new oil pools were being opened with almost monotonous regularity. The subject of valuation of established or prospective producing oil and gas properties is also one which the petroleum geological engineer has studied exhaustively and which often involves consideration of the previous history of adjacent or geologically related producing areas. Valuation has become very much a portion of the everyday work of the petroleum geological engineer and will also constitute an important part of his future work.

## The Task for the Chemical Engineer

It is scarcely necessary to mention that applications of civil, electrical and particularly mechanical engineering are of fundamental importance wherever oil is being produced and transported or natural gas distributed, as well as in relation to problems of refinery design and construction. The chemical engineer is intimately concerned with several special phases of production, among which may be mentioned problems of emulsification and petroleum hydrology. Apparently the chemist or chemical engineer is well fitted for a fundamental insight into the character of crude oil emulsions, and therefore possesses a sound basis for undertaking investigations as to the most efficient method to be used in their resolution and the control of processes after being established. Petroleum hydrology is the chemistry of oil-well waters and has very practical significance. The character of oil-well waters differs in different fields, but generally has the same trend in composition among the formations in a single field. These facts may have practical application as indicating, from the analysis of water in the various horizons, when the producing formation is being approached during drilling. Furthermore, after the well is completed, and water happens to appear with the oil in more or less troublesome proportions, analyses or tests of this water may be of value in locating the horizon where the water originates, providing previous analyses or tests have been made at the different horizons where water is present.

The relation of the chemical engineer to petroleum refining is of fundamental importance. In the future, as in the past, the chemist and chemical engineer may be depended upon to make the discoveries which mark important advances in this phase of the industry. Who, it may be asked, if not the chemical engineer or the chemist, is qualified, from the standpoint of training, to make a truly fundamental study of the problems of distillation, refining, "compounding" and the recovery and utilization of byproducts, or intelligently to control processes already established?

## Eliminating Waste

Important also is the problem of eliminating, wherever possible, the losses which occur. From the time the crude oil appears above ground until the finished products are obtained by refining, these losses occur, some of which may be wholly or partly eliminated. Important preventable losses often occur from evaporation during production and storage, and during refining from non-recovery of byproducts, inefficiencies in refining processes, leakage, evaporation, fire losses, etc. While the natural-gas phase of the petroleum industry has made commendable strides in recent years in regard to eliminating losses, there are still opportunities for preventing these during its transmission and distribution and while the product is being utilized. In no phase of the oil industry, however, will efficient operation, attention to details and elimination of loss and leakage give more tangible and immediate results than in that of natural-gas gasoline recovery. It is no unusual thing for an inefficient plant to be increased very materially in yield without change of design or the acquisition of new gas wells. At the refinery the oil must be taken as it comes from the pipe line, but in the natural-gas gasoline plant it is possible, and furthermore desirable, in order to obtain the best results, to give consideration to conditions in the field lines

*A paper presented in part at the Birmingham meeting of the American Chemical Society, April, 1922.

and even in the wells themselves, and thus to improve materially the quality and quantity of the gas obtained.

### Developing New Industries

We are told that the peak of petroleum production is to be expected within a comparatively short time and that it will then become necessary to supplement the supply of petroleum from oil wells by production obtained artificially by the retorting of pyrobitumens such as lignite, coal and oil shale. Many of the problems that will develop in connection with this new industry will be peculiarly chemical. Before such an industry can be established on a commercial scale in this country, important problems of retorting, refining and recovery of byproducts must be solved. These problems are such as to attract the attention of the research chemist and chemical engineer, to stimulate his interest and will therefore result in productive research. After these problems are solved, the efficient control of the processes established will demand the best efforts of the chemical engineer.

It has been suggested, however, that this new industry in America will be in no sense a byproduct industry, but instead will develop along lines similar to the treatment of low-grade ore. In view of past experience and the fact that conservation can be made to pay its way, it would appear that the coming shale-oil industry will be comparable with the best practice in byproduct technology and that possible developments in refining of shale oil may result in recovery far surpassing in its variations that of the industry as now carried on in Scotland. Handling oil shale as low-grade ore is handled would probably ultimately result in such difficulties as many of the petroleum skimming plants of the mid-continent are now involved.

### Petroleum Engineering Curricula

Taking everything into consideration, therefore, it is recognized that the chemist and chemical engineer have a fundamental place in the scheme of things in the bitumen industries, and this position is to become more important as the value of raw materials increases and as the economic necessities demand more efficient operation and attention to byproducts. This condition will no doubt then be reflected in a greater interest of universities in the subject of bitumenology. At the present time petroleum education is confined mainly to those universities the geographical location of which gives them special interest. In this connection may be mentioned the University of Pittsburgh, University of California, University of Oklahoma and the Colorado School of Mines. Dr. Roswell H. Johnson of the University of Pittsburgh was one of the first in this country to establish a course in petroleum engineering.

### Problems in Outlining Courses

In establishing a curriculum in petroleum engineering, the following questions arise:

(1) Is it desirable to outline a course so that all the technical phases of the industry, including the principles of chemistry, physics, geology, engineering, economics and several special courses related to the oil industry are studied in a 4-year course; or

(2) (*a*) To outline a course as a whole so that the student completes in 4 years a course in petroleum chemical engineering which specializes in refining and where chemistry is made paramount; or

(*b*) To outline a 4-year course which is designated as petroleum geological engineering and stresses the study of geology; or

(3) To organize a 5- or 6-year course which shall be considered complete from the standpoint of chemistry, physics, geology, engineering and economics, equal attention being directed to both geology and chemistry.

A course according to this latter scheme would be ideal, and in addition to the more complete and better balanced training acquired would present greater opportunity for a thesis based on real research. On the other hand, the difficulty in connection with such a course would be that the bachelor's degree in most educational institutions can be acquired in 4 years, both in arts and sciences, and engineering.

### Oklahoma's Course in Petroleum Technology

The writers are unable to understand how a complete course as outlined above, which includes the fundamentals of engineering besides those of chemistry, physics, geology and economics, can be completed in 4 years with equal stress being laid on both chemistry and geology. After all, the fundamentals really are the essentials, and when it is assumed that these have been acquired, it is then quite permissible to give special courses in petroleum technology. In the following paragraphs, courses in chemical petroleum technology are outlined which require as prerequisites university credits in general, qualitative, quantitative and organic chemistry and physics. These courses are open to all students of the university who can satisfy the requirements. Advanced organic chemistry, general physical chemistry and colloid chemistry are considered as important adjuncts to the work from the standpoint of chemistry. Titles of the individual courses in petroleum technology in the Department of Chemistry at the University of Oklahoma are as follows:

*Chemistry 132.* Petroleum and Natural Gas Technology. Lectures 3 hours a week during one semester.

*Chemistry 137.* Analysis of Petroleum and Petroleum Products. Laboratory 9 hours per week throughout one semester.

*Chemistry 138.* The Technology of Coal, Oil Shale and Asphalt. Lectures 3 hours a week during one semester.

*Chemistry 139.* The Analysis of Coal, Coal Tar, Oil Shale and Asphalt. Laboratory work 9 hours a week throughout one semester.

*Chemistry 140.* Lubrication, Lubricants, Liquid Fuels and Hydrocarbon Chemistry. Lectures 3 hours a week during one semester.

*Chemistry 142.* Gas Analysis. Laboratory 6 hours a week during one semester.

*Chemistry 143.* Petroleum Refining. Laboratory 6 hours a week during one semester.

*Chemistry 144.* Special Petroleum Products. Laboratory work 6 hours a week during one semester.

*Chemistry 145.* Field Work in Petroleum Technology. The testing of natural gas for natural-gas gasoline content, measurement of gas wells, testing of meters in the field and tank gaging and sampling. Equivalent to 6 hours of laboratory work a week during one semester.

*Chemistry 146.* Petroleum Research. Nine or fifteen hours laboratory a week during one semester.

In addition to the courses outlined above, there is listed a course in bitumenology for which elementary chemistry is the only prerequisite, and it is designed to meet the needs of students other than those majoring in chemistry.

Candidates for the degree of Bachelor of Science in Chemical Engineering at the University of Oklahoma may follow one of three lines of chemical engineering—viz., (1) Metallurgical chemistry, (2) petroleum technology (petroleum chemical engineering), (3) sanitary chemistry. It has been previously mentioned that the general course in petroleum technology (petroleum chemical engineering) includes the special courses in

petroleum technology outlined above, and some work in geology, besides the fundamentals of chemistry and engineering. In connection with special petroleum lectures, it should be noted that the general course in petroleum technology includes a course in petroleum geology given in the Department of Geology, and a course in the transportation of crude oil and the transmission, measurement and compression of natural gas, in the Department of Engineering, School of Mechanical Engineering. A title synopsis of the general course in petroleum technology (petroleum chemical engineering) follows for the sophomore, junior and senior years:

SECOND YEAR

*First Semester.* Quantitative analysis; Organic Chemistry lectures; General Metallurgy lectures; Calculus; and Physics.

*Second Semester.* Water analysis; Organic Preparations; Petroleum Technology lectures; Analysis of Petroleum and Petroleum products; Calculus; and Physics.

THIRD YEAR

*First Semester.* Physical Chemistry lectures; Geology; Applied Mechanics; Graphics; Thermodynamics; Mechanical Engineering laboratory.

*Second Semester.* Industrial Chemistry lectures; Physical Chemistry Laboratory; Gas analysis; Geology; Strength of Materials; Materials laboratory.

FOURTH YEAR

*First Semester.* Colloid Chemistry lectures; Petroleum Refining laboratory; Direct current machinery lectures; Economics lectures; Direct Current laboratory; Petroleum Geology; Technical English; Oil and Gas measuring and transmission and compression of natural gas.

*Second Semester.* Field work in Petroleum Technology; Alternating current lectures; Alternating current laboratory; Contracts; Accounting; Petroleum Research; Electives as follows: Chemistry 140 and 143, or Chemistry 138 and 139.

The special equipment for work in petroleum technology should include standard apparatus for the testing and analysis of the native bituminous substances and their important products, as well as experimental apparatus for the processing of crude petroleum, apparatus for field work, retorts for low-temperature pyrolysis of pyrobitumens, and apparatus for the manufacture of special products. At the University of Oklahoma the special equipment consists of an experimental refinery of 1-bbl. capacity, a low-temperature retort of about 20 to 25 lb. capacity, complete standard testing equipment and apparatus for field work.

CONCLUSIONS

It may be appropriate to inquire as to what a graduate in Petroleum Chemical Engineering should know, aside from the fundamentals of chemistry, engineering, physics and economics, which, as most everyone will agree, are absolutely essential. The writers would like him to have a thorough understanding of the characteristics and peculiarities of the native bituminous substances; their physical and chemical properties; how to test and differentiate them; how to refine them; and finally how to utilize them in their many applications. In addition to this, is is desirable that he should have an appreciation of the possibilities of research and to be of such a frame of mind that too much is not taken for granted. Furthermore he must realize that there are some things which can be learned only by experience after his studies are completed.

The present paper has been an attempt to discuss the different aspects of petroleum education as based on the results of several years experience in an endeavor to establish suitable courses in chemical petroleum technology. In concluding this discussion the writers wish to state that they believe the future of this work to be most encouraging, especially in view of the interest shown in it both by chemists and by the oil companies which employ these men. A plan which has been suggested to the writers is that oil companies could profit by selecting promising men from the freshman or sophomore classes in universities and colleges, directing them to study along lines having a bearing upon the business, giving them summer employment, and then finding places for them in their organizations when they graduate, provided they meet their expectations. In fact this plan is already being followed, to some extent, by certain important oil companies.

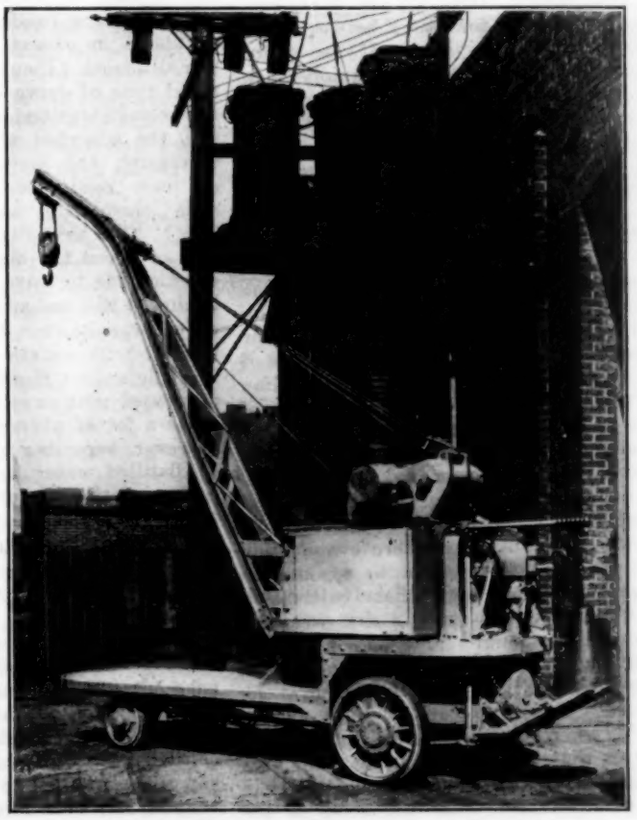
Norman, Okla.

## A New Electric Crane Truck

The Elwell-Parker Electric Co., of Cleveland, Ohio, has recently placed on the market the electric crane truck shown in the accompanying photograph.

The capacity of this crane truck is just less than that of the smaller industrial steam or gas operated locomotive cranes. It has a lift capacity of 3,000 lb. at a 6-ft. radius and 1,000 lb. at a 12-ft. radius. It can stack loads to a height of 12 ft. when set to lift 3,000 lb. at 6 ft. radius. This work is accomplished without the use of outriggers.

The truck has been specially designed of a heavy construction which will give stability and stand the strains of lifting. The boom and hoist, being independent of the driving motor, may be operated while the truck is in motion. All the standard Elwell-Parker truck features are incorporated in the new design. This truck is claimed to be the largest capacity electric industrial crane truck manufactured.



NEW ELECTRIC CRANE TRUCK

## Synopsis of Recent Chemical & Metallurgical Literature

### Physico-Chemical Problems Relating to the Soil

The *Transactions* of the Faraday Society, vol. 27, part 2, reports a general discussion held on May 31, 1921. Following the introductory remarks of Prof. A. W. Porter and Sir A. D. Hall, are two papers by E. J. Russell and G. W. Robinson. Then come five papers on "Soil Moisture" by B. A. Keen, Prof. Sven Odén, C. A. Shull, Prof. D. R. Hoagland, and F. E. Haskett; three papers on "Organic Constituents of the Soil," by H. J. Page, S. Odén, and E. J. Salisbury; three papers on "Absorption Phenomena," by E. A. Fisher, E. M. Crowther, and C. G. T. Morison; and three papers on "Colloidal Phenomena," by S. Odén, N. M. Comber, and J. W. Mellor. A General Discussion of Capillarity comes next, with papers by Allan Ferguson, P. E. Dowson, and by F. C. Thompson.

The discussion of all these papers is particularly trenchant and admirable. We are too prone to accept without question the experiments, formulas, and conclusions of others, especially of those who have big reputations. It is only by continually questioning our own work as well as the work of others, all in a friendly and impersonal spirit, that we get a more perfect view of the total truth. It is surprising how new unsuspected factors will appear and modify our views and conclusions.

The papers bring out the three-cornered struggle for water between soil, plant, and atmosphere. If the plant transpires moisture more rapidly than the soil will give it up, the plant wilts. At the wilting coefficient, the soil withholds water from the plant with a force of about 4 atmospheres and there is always some water held by the soil despite the osmotic pull of the plant which usually runs over 7 atmospheres. A wheat crop usually transpires about 1,000 tons of water per acre. But the water moving to the roots must bring with it the necessary plant food, or the plant will not thrive. In none of the various papers is consideration given to the "capillary phenomenon" of Bechhold, about which there has recently been some discussion in *Science* between the reviewer and Dr. Frierson. Soluble salts in plaster of Paris, soil and similar capillary bodies, move toward the surfaces where evaporation occurs, and this seems to account in part for the fact that cultivation (tillage) helps plants in dry weather. For even though some soil water be lost by increased surface evaporation from the soil immediately adjoining the plant, the recent work of H. A. Noyes (*J. Ind. Eng. Chem.*, Feb., 1922) indicates that the plant actually transpires less water when the water is richer in food. The soil near the roots is enriched by the capillary rise of salts due to increased local evaporation, which curiously thus conserves the total soil moisture. Cultivation therefore allows moisture to accumulate in the soil when rain is plentiful. Furthermore, it tends to increase the speed at which water reaches the neighborhood of the roots, and thus wards off wilting.

The work of Bouyoucos on the condition of water in the soil should be of interest to those who think that all attraction of this kind is "chemical," especially since F. W. Parker recently showed (*J. Am. Chem. Soc.*, 1921, p. 1011) that finely divided insoluble substances depress the freezing point of water, benzene and nitrobenzene and concludes that "the force holding water or other liquid films on solid particles and causing a freezing-point depression is adhesion."

When humus exercises a deflocculating action, as in the presence of soda or similar alkali, the effect on the soil is bad, for the colloidal matter washes down and may aid in forming a pan. Lime (usually present) forms "calcium humate" which is insoluble and aids in giving soil the desirable tilth, or fine granular state best suited to plant growth.

The papers show that the prevailing view is that the soil is a mineral framework surrounded by a jelly-like layer. But there is conflict between the "chemical" and "absorption" theories of the breaking up of salts in soils. Dr. W. R. Ormandy in discussing Prof. Odén's view that the "breaking up by adsorption is highly doubtful," reported experiments made with pure china clay (aluminum silicate) chosen to minimize the number of variables. In estimating by electric conductivity the amount of alkali in excess of what the clay would adsorb (about 0.2 per cent), the usual type of curve was obtained when the voltage was under 1.68 volts. Above this the adsorbed alkali was set free, increasing the conductivity; but it is at once readsorbed. Is the caustic soda chemically combined with the clay? "We have found that clay which has adsorbed the maximum amount of caustic soda to leave a neutral solution behind it will not adsorb copper, nickel, or other salts, but that such clay not treated with caustic soda does adsorb metallic salts. Similarly clay which is saturated with caustic soda will adsorb quite a lot of phenolphthalein without, however, becoming in any way colored. If distilled water have clay suspended in it, and the mixture be titrated with caustic soda, alkali will be adsorbed and it will appear as though it were an acid, but if the alkali be estimated electrically, such adsorption will not be found if a voltage of over 1.68 be employed."

It will be interesting to see how these observations of Dr. Ormandy will influence our judgment as to what happens when proteins are brought to the isoelectric point, or their hydrogen ion concentrations are determined. The adsorptive action of soils is so powerful, that as Mr. Veen remarks in his paper, "It is quite an easy matter to remove liquid from soil, of course, but it is another matter to say whether the liquid so removed is a true sample of the soil solution as it exists *in situ*." Considerations like this are interesting in connection with experiments recently reported by Dr. J. Loeb wherein he decanted from swollen gelatine particles the supernatant fluid and then determined separately the hydrogen ion concentration of the gelatine and of the decanted fluid. It is a question as to how acid or alkali are fixed, not only by proteins but also by many other "amphoteric" substances, like clay. E. A. Fisher advocates the use of the term "sorption" as suggested by McBain, "a word which emphasizes our ignorance of the nature of many of these reactions and which does not commit us to any particular theory."

JEROME ALEXANDER.

## Book Reviews

A MANUAL OF FLOTATION PROCESSES. By Arthur F. Taggart, New York: John Wiley & Sons. 181 pages. Price $3.

The evident intention of the author has been to write a book for purposes of instruction in ore-dressing classes or for other students of flotation. From this standpoint the book is remarkably well written. It is divided into four chapters, consisting of an introduction, a chapter on laboratory testing equipment, a chapter on testing and a chapter on mill data. One other avowed purpose of the book is stated in the preface, "to counteract the further spread of false conceptions concerning flotation concentration, by setting forth some of the essential facts which contradict them." This statement immediately follows a condemnation of Minerals Separation for its policy of opposition to the spread of knowledge of the process and "their unfounded claims that all processes prior to that described in U. S. Patent 835,120 were laboratory curiosities or commercial failures and that those subsequently discovered were merely improvements of that process." Evidently with this in view, a very clear exposition of the different methods of flotation is given, the division being made into skin flotation, (bulk) oil flotation and froth flotation. The author further subdivides froth flotation into pulp-body concentration processes and bubble-column processes. He claims that the concentration of flotative mineral particles onto bubble surfaces takes place in the body of the pulp in processes like the old style agitation Minerals Separation process, whereas in pneumatic machines of the Callow type, where a deep column of evanescent bubbles is formed, the selection of flotative minerals takes place in the bubble column and the gangue drops out of it. The two chapters on laboratory testing machines and on testing are very well written and should be adapted to class instruction. The chapter on mill data contains

drawings of different types of commercial machines, typical flow sheets, formula for calculations involved in mill control and a few conversion tables. This book should fill the need for a laboratory manual suitable to college classes. A more extensive treatise on flotation is to follow in another volume.

OLIVER C. RALSTON.

---

WITHIN THE ATOM, a popular view of electrons and quanta. By *John Mills*. 215 pp., 5x7½ in. New York. D. Van Nostrand Co. 1921. Price $2.

As the name indicates, this little book is a Cook's tour through the new physics. Not the physics which we were taught in high school and college—the physics which had to do with matter in the aggregate, chunks of matter which you could weigh, energy waves which you could see, hear or feel, or electrical currents which you could measure—but the physics which has to do with matter (or is it energy?) in the ultimate, a subject which our ancestors might even call metaphysics.

At times the author appears in the pitiable plight of the Senator who is both for and against the bonus. He must talk to an audience which presumably knows no science, yet tell it of the speculations of the most scientific. So he explains the meaning of such terms as "component" and "absolute zero," and on the next page says "Ionizing impacts in a conducting gas usually remove a single electron from such stable structures as the inert atoms." On the horns of such a dilemma Mr. Mills stages about midway in the book a vaudeville stunt wherein Proton, Electron, Voice of Energy, Author and Reader—both scientific and general—crack jokes and jazz things up generally. This was so fatiguing that the remaining chapters were negotiated with difficulty.

On the whole, the book is an excellent illustration of the fact that its reaction on the reader depends a great deal upon his understanding of the subject. Chapters on the periodic table, radioactive disintegrations, X-rays and atomic numbers are clear and excellently written. On the other hand, equally skillful chapters on Isolating a Proton and Quantum of Energy are much harder reading—that is, to the present reviewer. Another whose general stock of information is more physical than chemical would doubtless reach exactly the opposite conclusion. In other words, if you already know something of the matter, the book will be interesting—if you don't, it will be pretty dry.

Well-informed people—be they engineers or just "folks"—will want to know something about the recently acquired information on the constitution of matter. Most of them will have to depend upon such books as this, and there is no reason why they should not start in on Mr. Mills' little book. But please don't let him get you worried over the fact that energy is no longer thought to be transmitted continuously—that is, by infinitesimal amounts. No, it is not so; it is reasonably certain it is discharged, in chunks, quanta, so called. A quantum may be as large as $5 \times 10^{-12}$ erg; which of course is quite sizable to an active imagination!

E. E. THUM.

---

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTY. By *J. W. Mellor*, D.Sc. London and New York. Longmans, Green & Co., 1922. $20 net per volume. Volumes I and II.

The reader will find this review a distinctly prejudiced one. Some years ago we studied a book by Dr. J. W. Mellor called "Modern Inorganic Chemistry." In fact, we nearly memorized it. All the facts in inorganic chemistry which were not in that text, hung upon the outline presented in the book much as one hangs crystal balls and ornaments on a Christmas tree. Well, anyway, we passed the examination and that book has thus become associated with successful conquest. We love it and when we turn to review its big brothers we realize that we are inevitably prejudiced in their favor.

It can safely be said upon the evidence of the first two volumes that this monumentally conceived work is based upon the shorter text, "Modern Inorganic Chemistry." It gives the same perspective, the same development of the subject and to a large extent the same order of treatment, although it is of course expanded so that it gives the whole story and not a part of it. In general, the treatment of any subject is historical with the high points of fundamental research all mentioned together with original references thereto. The chronological development of each subject is stressed and numerous references within the last two years are evidence that the work is up to date.

We were amazed and altogether pleased to find that the text is readable. We had rather expected to find it simply a compilation of data, a somewhat elaborated Landolt-Boernstein. It is not that kind of a book at all. It is correctly named "a treatise," for it developes chemical theory according to a definite plan, much as a text book would.

It can hardly be considered a text book except for advanced students who will find it invaluable. As a reference book for studying the development of any subject in inorganic chemistry it is accurate and complete. It will undoubtedly have its greatest use in that capacity although we commend it most heartily to serious students of inorganic chemistry who desire to obtain a comprehensive idea of the subject.

Volume I contains a complete discussion of chemical theory developed systematically and as far as any given point is concerned chronologically. As mentioned above it follows the general plan of "Modern Inorganic Chemistry," and this presentation is excellent. We do not think it would be as good for elementary work as, for example, MacPherson and Henderson, but it is by no stretch of the imagination an elementary text book. Volume I also contains a discussion of hydrogen and oxygen and their properties at a point convenient to the better presentation of the gas laws. Volume II contains the halogens and the alkali metals.

The typography is good. The references to literature are all grouped at the end of each section and there are many points which commend this practice although in some ways it is not so convenient as including them as footnotes. The references are in excellent type, the names of the authors and the source being printed in different type as well as the volume numbers and date and page numbers. This makes it exceedingly easy to pick out references. In the text itself in discussing elements or compounds, the physical properties are printed in heavy type, that is to say, a sentence will begin, "The **density** of calcium chloride." This procedure is excellent and makes it extremely easy to locate the physical property in which one is particularly interested and to obtain data quickly and easily. So also in historical discussions, important words are printed in heavy type. In this respect the book is about as nearly perfect as any with which we have come into contact.

The dedication is interesting—"To the privates in the great army of workers in chemistry. Their names have been forgotten; their work remains." Of course the price of the book is rather prohibitive for the individual "private in the great army of workers in chemistry" and so its distribution will be largely in libraries of corporations, universities and technical societies, but its usefulness is great. Professor Mellor has rendered a great service and rendering that service will be his greatest reward unless it be the largely unvoiced thanks of the privates for whom he writes.

CHARLES WADSWORTH.

---

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. Thirtieth annual edition for 1922. 2,324 pp. New York: S. E. Hendricks Co., Inc. Price, $15.

No more convincing proof of the fact that chemistry is an inseparable part of industry can be found than by a study of some comprehensive trade directory such as this new edition of Hendricks'. The products of the chemical and chemically controlled industries enter into practically every ramification of the manufacturing field. To be acquainted thoroughly with all these products as well as the raw materials from which they are derived is obviously beyond the ken of even the technically trained purchasing agent or sales manager. These are the men, however, for whom this book can render yeoman's service. Manufacturers and producers of chemicals and

cognate materials, chemical apparatus, equipment, machinery, containers—in fact, every requirement of the chemical industries—are adequately covered under a suitable heading and are conveniently cross-indexed under a half dozen others. Next comes the lists of hundreds of jobbers and dealers specializing in the sale of chemicals and chemical supplies. And last, but perhaps of most importance, are the consumers—from the smallest chemical laboratory to the largest industrial plant. Thus the picture of industry is complete, for we have production, distribution and consumption, from the crudest raw material to the most intricately fabricated finished product.

The outstanding improvement in the new edition is the change in the type page to the generally accepted standard size. In its new size the larger page (8¼x11¼ in.) naturally carries more printed matter and gives a thinner book, which in turn is easier to handle. According to the publisher's statement in the front of the book the increased size of the page would normally reduce the number of pages from 2,800 to 2,100, but enough new material has been added to bring the total up to more than 2,300 pages. As in earlier volumes, the various sections of the book are prominently set apart by different coloring of the front edges of the pages. The first section (blue) is an index to trade classifications and in it every product listed in the book is indexed and cross-indexed for ready reference. This is followed by the classified trade (red) covering 17,145 different classifications. The third section (white) is an alphabetical list of about 20,000 trade names, private brands, etc., together with the name and address of the manufacturer. From personal experience and without hesitancy the present reviewer is willing to testify to the daily usefulness of this very important section. The volume is completed with an alphabetical list of all firms whose products are listed in the book, together with their addresses and principal business.

S. D. KIRKPATRICK.

# Recent Chemical & Metallurgical Patents

## British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

**Potash From Silicates**—This specification relates to the treatment of silicates, such as potassium-bearing silicates and clays, in order to recover their constituents in commercially available form. The silicate is fused with boron trioxide, or any substance that yields boron trioxide at a high temperature and the resulting melt suspended in water and treated with sulphur dioxide. Bisulphites of the metals present pass into solution, while silica remains undissolved and is filtered. The filtrate is boiled, whereupon sulphur dioxide is evolved, the bisulphites converted to sulphites, and aluminum precipitated as hydroxide. The precipitate is filtered and the filtrate boiled, in the presence of air, to oxidize sulphites to sulphates. At the same time any iron present is precipitated and filtered. The filtrate then contains sulphates of the alkali metals, if present, and boric acid. The constituents are separated by fractional crystallization, and the boric acid used again. (Br. Pat. 177,736. E. Levitt, Montreal. May 24, 1922.)

**Bleaching Earths**—The activity of bleaching earths comprising aluminum hydrosilicates, such as fullers earth and floridin earth is increased by treating them in the cold with dilute acid, such as hydrochloric or sulphuric acid of 1 per cent strength. The earth is afterwards filtered, washed with water, and dried. Known processes comprising cautious heating to expel hygroscopic water, or boiling for 2 hours with hydrochloric or sulphuric acid of 15 per cent strength to produce for example "Tonsil" or "Franconite" are referred to. (Br. Pat. 176,353. Not yet accepted. Schweizerische Sodafabrik, Zurzach. April 26, 1922.)

**Hyposulphites** — Hyposulphites are produced by reducing bisulphites by means of an amalgam such as sodium amalgam in the presence of an acid such as sulphurous, sulphuric, or hydrochloric acid. The quantity of acid added is preferably equivalent to the metal dissolved in the mercury. The amalgam may be produced electrolytically and led by a siphon to a closed vessel containing the bisulphite solution, the mercury being returned to the electrolytic cell. (Br. Pat. 176,344. Not yet accepted. Bayer & Co. Leverkusen. April 26, 1922.)

**Metaldehyde** — The stability under heat of metaldehyde prepared by the catalytic polymerization of acetaldehyde is improved by transforming the residual traces of catalyst into substances devoid of catalytic action or by eliminating any adhering paraldehyde. Thus, if sulphuric or hydrochloric acid has been employed as catalyst, a barium or silver compound respectively may be added; adhering paraldehyde may be removed by washing with acetaldehyde or by gently heating in *vacuo*. (Br. Pat. 176,319. Not yet accepted. Elektrizitätswerk Lonza, Basle. April 26, 1922.)

**High Explosives**—Crystalline compounds of the mixed crystals and double salts type containing the potassium salt of dinitrodinitrosobenzene and difficulty soluble salts of azoimide, tetrazol derivatives, or mono- or poly-nitrated phenols, for example lead azide, azotetrazol and tetrazylazoimide salts, trinitroresorcinates, and trinitrophloroglucinates, are employed for loading ammunition generally and as a top charge in detonators. (Br. Pat. 177,744. H. Rathsburg, Fürth, Bavaria. May 24, 1922.)

**Activated Carbon**—Consists in subjecting wood charcoal to a partial vacuum, impregnating with alkali, caustic or carbonate, heating to a high temperature such as a bright red heat and extracting the alkali. In an example, 200 parts of wood charcoal are subjected for half an hour at 20 deg. C. to a vacuum of 720 mm. of mercury and then impregnated with a solution of 250 parts of potassium carbonate in 250 parts of water. (Br. Pat. 179,108. W. Carpmael, London. June 21, 1922.)

**Formaldehyde**—Formaldehyde is obtained by passing a mixture of acetaldehyde and oxygen, air or other oxygen-containing gas over a heated catalyst, especially a metal or a metal oxide; suitable catalysts are copper, silver, or other metals forming easily reducible oxides, and also oxides of metals forming several oxides, for instance, vanadic and cerium oxides; steam or indifferent gases may be present. According to an example, air containing acetaldehyde is led over a coil of copper wire netting and then into water. Unchanging acetaldehyde is separated by fractional distillation from the solution of formaldehyde obtained. (Br. Pat. 178,842. Not yet accepted. Consortium fur Elektrochemische-Industrie Ges., Munich. June 21, 1922.)

**Borneol and Camphor**—Borneol is obtained by treating pinene hydrochloride with a hydroxide, such as calcium hydroxide, or with boiling water.

Camphor is produced from pinene hydrochloride by simultaneous treatment with an oxidizing agent and a "dehydrogenizing" substance. Metallic oxides and peroxides, such as iron oxide and lead peroxide, are given as examples of oxidizing agents; bisulphates, such as potassium bisulphate, and bicarbonates are mentioned as "dehydrogenizing" substances. Camphor may also be produced by treating borneol with a peroxide or the like. (Br. Pat. 178,797. Not yet accepted. A. Gawalowski, Brünn, Czecho-Slovakia and L. Kutter, Vienna. June 21, 1922.)

**Plastic Composition**—A plastic composition for covering walls, floors, and other surfaces and for making moulded articles consists of 33 lb. of magnesite rendered caustic, 11 lb. of wood-meal, and 5 lb. of limestone meal mixed into a stiff paste with a 20 per cent solution of magnesium chloride. 2½ lb. of talc and 2½ lb. of colouring-matter may be added to the ingredients. An imitation marble is produced by rubbing the paste through a 1 cm. sieve to produce granules, mixing differently-coloured granules together and subjecting to pressure. When used for covering floors, tables, etc., the composition is applied to a backing consisting of a wooden framework interstices of which are filled with a mixture of wood-meal, magnesite, and magnesium chloride solution. (Br. Pat. 178,880. M. Chesterton, St. Margarets-on-Thames. June 21, 1922.)

# Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

## Grand Jury Investigates Chemical Foundation

### Manufacturers Express Confidence in Administration of Foundation and Point Out Baleful Effect in Administration of Foundation ment of Justice Interprets Government's Action

THE Grand Jury investigation of the Chemical Foundation is under way. Mr. Garvan and the books of the Foundation are in Washington. Important developments were lacking during the past week. The demand of the President, the charges of German influence by Mr. Garvan and the instigation of criminal proceedings against the Foundation followed each other like so many bombshells. Now, apparently, the fireworks are over for the present. In the meantime, however, the industry as a whole, having recovered somewhat from the shock, is beginning to figure out the ultimate results of the whole affair.

#### Formal Refusal by Garvan

As previously announced by Mr. Garvan, the Chemical Foundation has no intention of complying with the President's demand. In a letter transmitted to Alien Property Custodian Miller, Mr. Garvan officially proclaimed this stand. The text of the letter follows:

Hon. Thomas W. Miller.

Dear Sir:—This will acknowledge the receipt of your communication dated July 6, 1922, demanding that this company return and deliver to you all patents, trade-marks and copyrights heretofore assigned to this company by the Alien Property Custodian, that the company account to you for all income received by it from such patents, trademarks and copyrights, and that the company forthwith cease to exercise any dominion over such trademarks, copyrights and patents.

In reply thereto you are advised that this company is the owner, in its own right, of all the aforesaid patents, trademarks and copyrights and of the income derived therefrom. The company denies that the United States Government, or you, as Alien Property Custodian, or any one other than this company has any right, title or interest in said patents, trade-marks and copyrights. The company, therefore, declines to comply with your demand in any particular whatsoever.

The communication was signed by Mr. Garvan as president of the Foundation and William D. Guthrie as counsel.

The Foundation president also sent a long letter to the Chief Executive explaining his position and that of his company. The letter, which is dated July 14, says that "the American public, in whose interests this corporation was organized, is entitled to be fully informed as to the circumstances under which this demand was made and the reason why it is unqualifiedly refused."

"The Alien Property Custodian," continues the letter, "stated no authority or reason for his demand for the entire property and assets of this corporation for an accounting of all its past business and for the entire cessation of its activities, except that he was acting by your express direction. I am therefore compelled to imply that he was acting under the letter given out by you and the statement of the Attorney General accompanying it.

"These two papers demonstrate that you, Mr. President, have been grossly misled by the Attorney General, both as to the law and the facts of this case."

Mr. Garvan then quotes at length from a report of A. Mitchell Palmer dated Feb. 22, 1919, in which Mr. Palmer announced the sale of 4,500 patents for $250,000 and announced that the new company would be able "to commence immediately and prosecute with the utmost vigor infringement proceedings whenever the first German attempt shall hereafter be made to import into this country." In the Palmer report he referred to Mr. Garvan, the first president of the Chemical Foundation, saying of him " * * * to whose vision and indefatigable industry I am chiefly indebted in the working out of this plan."

Mr. Garvan's letter to the President continues:

"Note that at the time this was written I was a dollar-a-year man, with no expectation of becoming Alien Property Custodian, and at a time when I thought my own war services were over and I was about to return to New York to resume my law practice."

The letter includes a summary of the finances and activities of the Foundation.

#### Manufacturers Back Foundation

"Nothing could be more disastrous to the American industry than the return to the former German owners of the patents now owned by the Chemical Foundation; nothing could be of greater aid in restoring to the German chemical cartel the monopoly formerly enjoyed." Such is the statement in a memorandum submitted to the President at a conference at the White House by a delegation of representative manufacturers of dyes, medicines and other synthetic organic chemicals.

The committee which conferred with the President included Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association of the United States; C. N. Turner, Newport Chemical Works, Passaic, N. J.; Alfred S. Burdick, The Abbott Laboratories, Chicago, Ill.; W. T. Cashman, Grasselli Chemical Company, Cleveland, Ohio; Samuel Isermann, Chemical Company of America, New York City; Charles A. Meade, E. I. duPont deNemours & Co., Wilmington, Del.; August Merz, Heller & Merz, Newark, N. J.; James T. Pardee, Dow Chemical Co., Midland, Michigan; Fred E. Signer, Butterworth-Judson Corporation, New York City; Herman Seydel, Seydel Manufacturing Co., Jersey City, N. J.; Franklin P. Summers, Noil Chemical & Color Co., New York; Salmon W. Wilder, Merrimac Chemical Co., Boston, Mass.; Edgar F. Queeny, Monsanto Chemical Works, St. Louis, Mo.; George A. MacIntosh, Butterworth-Judson Corp., New York, and Edward S. Rogers, The Bayer Company, New York City.

The statement points out that prior to the war there was practically no organic chemical industry in the United States; this was almost wholly controlled by the Germans and commodities necessary to the safety of the nation and the health and prosperity of the people were solely in their hands. The Germans took out many thousands of patents in the United States. They never exploited them. The sole purpose in holding these patents was to prevent the American manufacturer from building up an organic chemical industry.

The statement submitted by the manufacturers included a review of the circumstances leading up to the organization of the Chemical Foundation and the sale of the siezed property to it by the Alien Property Custodian. It was pointed out that the main consideration in the transaction was the assurance that these patents were to be held in trust for the benefit of the American people by the Foundation. They are non-exclusive in character and license to operate under them is open to every American citizen.

The American manufacturers who have taken out licenses had implicit faith in the authority of the United States Government to make the sale to the Chemical Foundation. Relying upon this authority and believing that the Government desired to foster and encourage an industry vital to the

needs of the country they have invested over $100,000,000, and this will be entirely lost to them, and the loss to the country irreparable if these patents are restored to the Germans.

The attitude of the organic chemical manufacturers toward the administration of the Chemical Foundation is evidenced by the resolution passed by the Board of Governors of the Synthetic Organic Chemical Manufacturers' Association at the meeting held on July 11, 1922, which "expresses (1) its appreciation of the patriotism and forethought of those representatives of government and industry who conceived this plan; (2) its entire confidence in the administration of the affairs of the Chemical Foundation; (3) and records its appreciation of the personal sacrifices of the Foundation's president, Mr. Francis P. Garvan, who, at the solicitation of the founders of the organic chemical industry in the United States, accepted the presidency of the Foundation at its inception and since that time, without remuneration, has administered disinterestedly its affairs in behalf of the welfare of the people of the United States."

### Department of Justice Statement

The Department of Justice has issued a statement relative to the government's purpose in proceeding against the Chemical Foundation. Officials of the department say that representatives of the German cartel, comprising the organic chemical industry of Germany, called at the Department of Justice recently relative to thirty-odd suits to be instituted by them against the government on behalf of their clients, but that they had absolutely nothing to do with any action of the department against the Chemical Foundation. It was pointed out that the Department of Justice had been investigating the transaction between the Alien Property Custodian and the Chemical Foundation for many months prior to the arrival of the German representatives, as Mr. Garvan and his associates well knew, and prior to the action of the Chemical Foundation in precipitating an unexpected situation by bringing sixty-seven suits against the government, involving a very large sum of money.

It is pointed out that the return of these patents to the Alien Property Custodian would in no sense benefit the former German owners or interests. The action taken by the government has been wholly in the interest of the government itself. The disposition of these patents after return to the Alien Property Custodian, as well as all enemy property held by him, must be determined by action of Congress.

## Civil Service Openings Announced

The U. S. Civil Service Commission has announced an open examination for a microscopist to fill a vacancy in the Public Health Service in Memphis, Tenn. Applications should be made on form 1312 to the Civil Service Commission.

# Preliminary Program Announced for Fall Meeting of American Chemical Society

### Two Thousand Members Expected at Pittsburgh Convention in September—Strong Technical Sessions Scheduled but Entertainment Features Not Neglected

THE preliminary program for the Pittsburgh meeting of the American Chemical Society. which will be mailed to members the latter part of this week, gives promise of a splendid success. All of the regular divisions of the society and the five sections are planning extensive programs. The central location of Pittsburgh augurs well for the attendance and officers of the society estimate the probable attendance at 2,000. With the Chemical Exposition in New York the following week and the American Electrochemical Society meeting in Montreal after that, the month of September should be an outstanding one in the chemical field.

### Bargain Railroad Rates

The peculiar satisfaction that everyone experiences in getting a free ride on a "common carrier" will be the lot of each member who makes the trip to Pittsburgh, in some degree, at least. In view of the expected large attendance the railroads have agreed to sell round trip tickets at one and one-half fare on the certificate plan, the intricacies of which are too well known to be described here. Nevertheless, it will make a much more presentable expense account for members coming from a distance and those who were disappointed in the failure of the required number to register at Birmingham last spring will be pleased to know that this economy is assured.

The official registration at the meeting will begin Monday afternoon, Sept. 4. Pittsburgh's well known hostelry, the William Penn Hotel, will be headquarters for the registration and for the council meeting, which is scheduled for the same evening. The Duquesne Club has thrown open its doors to the councillors, who with their wives will be entertained there at dinner, Monday evening, after which theatre parties have been arranged for the ladies.

### General Meetings

The first general meeting will be held at Carnegie Music Hall on Tuesday morning. Prominent local officials will extend greetings and welcome to the visiting members and Edgar F. Smith, president of the Society, will respond—a prospect that will appeal to anyone who has had the pleasure of hearing Dr. Smith on similar occasions. Included in the formal addresses at this session will be two dealing with Pittsburgh as an industrial center. J. H. James will describe the historical and industrial features of the city and W. F. Rittman will discuss the phases of finance and transportation.

The second general meeting, the same afternoon, offers a program that could be equalled only with difficulty as far as the variety and current interest of the topics scheduled are concerned. No research conducted in the past year has stimulated more general interest or appealed more to the practical side of technologists than has the extensive work of the General Motors Corporation on motor fuel and anti-knock compounds. Thomas Midgeley, Jr. and T. A. Boyd, both of whom have been directly connected with these investigations, are to present a paper on "The Chemical Control of Gaseous Detonation with Particular Reference to the Internal Combustion Engine." The talk will be illustrated with slides and with the ingenious apparatus used in the experimental work.

E. J. Crane, editor of *Chemical Abstracts*, will present a paper on "The Journal Literature of Chemistry."

Wilder D. Bancroft is scheduled for a discussion of his novel conception of "Structural Colors in Feathers." Those who have been fortunate enough to hear Dr. Bancroft's talk on "Blue Eyes and Blue Feathers," at various sectional meetings will appreciate an opportunity to listen to a further exposition of this fascinating topic in the inimitable manner of Cornell's distinguished exponent of colloidal chemistry.

### Divisional Meetings

As stated above, the twelve divisions of the Society are arranging extensive programs for Wednesday and Thursday. In addition, the technical sessions will be augmented by the convening on five sections, including the newly-formed section of gas and fuel chemistry. All these sessions will be held at Carnegie Institute of Technology. Of special interest to the engineer will be the symposium before the Division of Industrial and Engineering Chemistry on "Automatic Process Control." The chairman, L. W. Parsons, has arranged with various authorities to present papers, many of them illustrated, bearing on the fundamental and practical aspects of the subject.

The Water, Sewage and Sanitation Division will discuss the specifications for lime for water treatment as a feature of the meeting. Under the chairmanship of David Wesson, the Biological and the Agricultural and Food Chemistry Divisions will hold a joint symposium on the subject of "Fatty Foods." In view of the recent developments in the study of vitamines at Johns Hopkins, this meeting should prove of timely interest. Papers dealing with the preparation, purification, digestibility and adulteration of various fatty foods are being solicited for this symposium.

The Rubber Division is planning an exceptionally live program, as the proximity of Pittsburgh to the center of the rubber industry will facilitate the attendance of representatives of the industry. The Leather Division has scheduled a symposium on gelatine and colagen. An important phase of the dye industry and one which has not previously received a proportionate share of attention, will be discussed by the Dye Division—"The Chemistry of the Application of Dyes." The Division of Physical and Inorganic Chemistry will hold a symposium on "Recent Advances in Applied Colloid Chemistry."

The Petroleum Section hopes to perfect its divisional organization at this meeting as provided by the Council at Birmingham last spring. The feature of the technical sessions will be a discussion of "Lubrication from the Chemist's Viewpoint." As previously announced in these columns, the newly-formed Gas and Fuel Section has arranged a symposium on "Combustion" under the chairmanship of R. T. Haslam, of Massachusetts Institute of Technology. The Cellulose Section has a number of papers on live topics on its projected program including "Co-operative Research Problems in Cellulose Chemistry," "The Nature of Oxycellulose and its Bearing on the Artificial Silk, Viscose and Paper Industries," "Dr. Tingle's Proposed Bromine Number" and "The Absorption of Salts by Cellulose." The Sections of Chemical Education and the History of Chemistry will be watched with more than usual interest in view of recent educational developments.

### Social Activities

The usual smoker, with unusual features (as yet obscure in the carboniferous atmosphere of the Smoky City) is planned for Tuesday evening at the commodious Syria Mosque. Being strictly a "stag party" the ladies will be entertained that evening at Carnegie Institute of Technology, where the Drama School has arranged to present a play for their special benefit.

Nor will the fair guests be given opportunity for thumb-twiddling during the divisional meetings for they are to be the guests of the Heinz factory on an inspection trip and at luncheon which will include the majority of the 57 varieties. In the afternoon a musicale at the Century Club has been arranged for their entertainment.

The public meeting, Wednesday evening, at Carnegie Music Hall will be followed by a reception. On Thursday evening, the University of Pittsburgh Faculty Club has arranged for a supper and garden party.

### Trips

The trips to nearby industrial establishments which are scheduled for Friday and Saturday will include visits to the famous steel mills in the vicinity and numerous other chemical industries which cluster about this city of industrial activity.

## All Muscle Shoals Offers Rejected

**Committee on Agriculture Turns Down Ford Offer with Others—Minority Reports To Be Submitted**

All of the offers for the Muscle Shoals nitrate plants and power site were summarily disposed of by the Senate Committee on Agriculture on June 15, when that body rejected Henry Ford's offer by a vote of 9 to 7. The Alabama Power Co., the Engstrum and the Parsons offer were turned down without the necessity for a roll call. Senator Norris' proposal for the government operation of the plants met a similar fate.

Senator Ladd, who voted for acceptance of the Ford offer, was authorized to draw up the minority report in favor of that proposition while Chairman Norris will write the report urging approval of the government-owned corporation plan. Both reports, it was said, will probably go to the Senate in the coming week, although it is not believed that any action on either of them will be taken at this session of Congress.

## Fire in Subway Brings Chemistry Home to Public

**Fumes Liberated by Carbon Tetrachloride Extinguishers Overcome Scores of Straphangers in New York**

The recent fire in the New York subway, during which one hundred and fifty persons were overcome by the fumes evolved by the volatilization of carbon tetrachloride has given rise to considerable comment on the part of the public and the daily press. As is usual in incidents of this kind, the newspapers carried lurid descriptions of the "acrid fumes of carbon dioxide" and other novel and revolutionary conceptions of elementary chemistry.

Making due allowance for the natural effects of the excitement incident with such an occurrence, it is fairly well established that a number of the victims were actually affected to a certain extent by the gases evolved from the use of carbon tetrachloride fire extinguishers. Fortunately, no one was seriously disabled. The occurrence served to emphasize the danger of the unintelligent use of this very efficacious material. Work by the Bureau of Mines has demonstrated that the decomposition products of carbon tetrachloride consist of phosgene, hydrochloric acid gas and sometimes chlorine. In addition, high concentrations of tetrachloride vapor are formed when the liquid is sprayed on a heated material. Death may be caused by breathing the gases for only a short time. It is obvious that the danger of such an occurrence is considerably greater in a confined space where there is not opportunity for the diffusion of the noxious gases.

A report issued by the Bureau of Mines, written by A. C. Fieldner, S. H. Katz and S. P. Finney, contains the results of the work done by the Bureau on this subject. The following extract is offered as an authoritative statement on a subject which vitally concerns the public welfare.

> Seven to nine per cent of carbon tetrachloride vapor mixed with air will extinguish fires. The heavy vapor tends to settle to the bottom of a room and forms a blanket on the floor.
>
> This blanketing effect on any material wet with carbon tetrachloride excludes air and so aids in extinguishing fires.
>
> Undecomposed carbon tetrachloride vapor, arising from the use of the liquid in fire extinguishers when encountered in a small, confined space will probably produce unconsciousness by its anaesthetic effect. The commercial product usually contains some carbon bisulphide, a residue of the carbon bisulphide used in its manufacture. Waller and Veley have found that the presence of carbon bisulphide vapor with that of carbon tetrachloride greatly increased the toxicity, but comparatively large amounts of the carbon tetrachloride vapor must be breathed before the effects become more dangerous. For this reason the more serious danger in the use of carbon tetrachloride lies in the products formed from it rather than from the vapor itself.
>
> An employee of the Bureau of Mines was overcome while using a carbon-tetrachloride fire extinguisher on an automobile burning in the open air. Two employees of the Navy Department died as the result of breathing fumes from carbon-tetrachloride that had been used when the clothes of one of them caught fire when the men were working in a very small compartment.
>
> Care must therefore be observed in the use of fire extinguishers of the carbon-tetrachloride type in underground fire fighting. Such extinguishers are in common use for putting out fires in and around electrical equipment, for carbon-tetrachloride is a non-conductor of electricity, and, indeed, such extinguishers should be a part of the equipment of all mine locomotives. The operator need not inhale the fumes, as electric locomotives usually are in well-ventilated entries or haulageways.

Steps have been taken to prevent a re-occurrence of such an accident by the removal of this type of extinguisher from subway cars in New York.

## Sulphuric Acid Plant Built in India

The Dharamsi Moraji Chemical Co. has built a sulphuric acid plant of 7,500 tons per annum capacity. This is the largest plant of its kind in India. It is reported that the factory will also manufacture superphosphates and the results are being watched with the greatest interest. This factory is one of the first built in the new Ambernath area on the G.I.P. Railway which is being developed by the Bombay Protectorate.

# Senate Votes Down Dye Embargo

## Bolt of Republicans Kills Finance Committee's Recommendation—Sentiment of Legislators Believed Influenced by Chemical Foundation Trial

TO THE surprise of each party to the dye embargo controversy, the Senate, on July 15, voted down the proposal of the Committee on Finance to continue in force for one year after the passage of the tariff bill the embargo provided in the dye and chemical control act approved May 27, 1921. The vote was 32 for the embargo and 38 against. It is believed that the action of the administration in proceeding against the Chemical Foundation influenced a number of Republican senators to vote against the embargo. An informal poll of the Senate, less than a month ago, showed a margin of 3 votes in favor of the embargo.

While Senator McCumber, the chairman of the Finance Committee, made it very clear before the vote was taken that the embargo and the patent situations are entirely distinct, it is believed that fact was not brought home to certain senators who apparently made an eleventh-hour change in their attitude. The fight is not over. Senator Frelinghuysen gave notice that he will demand another vote on the proposal when the bill is considered in the Senate proper. This vote was taken in committee of the whole.

### Herty Optimistic of Final Vote

Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers Association, characterized the action of the Senate as a severe blow to the American industry, but he believes the real test, whether America wishes to preserve its dye industry or turn it back into German hands, will come on the forthcoming vote. Continuing, Dr. Herty said:

"An analysis of the vote, to my keen regret, shows a solid Democratic vote against the embargo, in spite of the unanimous approval of this measure by consumers of dyes throughout the South. On the other hand, the division in the Republican vote, fourteen having voted against the embargo, shows clearly that there has been confusion of thought between two issues, patents and embargo, which logically have no connection in the consideration of this measure, as was so ably pointed out by Senator McCumber. I confidently believe that this confusion of thought will disappear and that when the measure comes before the Senate again it will receive that certain majority support which was so clearly evident before this question of patents arose."

The vote on the embargo paragraph was preceded by vitriolic attacks on the American dye industry by Senator Moses and by Senator King. Senator Moses said that if the embargo remains in the bill "we shall go before the country convicted of surrendering to an iniquitous, imprudent and avaricious monopoly." His attack on the American industry extends through 28 pages of the Congressional Record. Senator King's attack, which was largely a reiteration of his oft repeated charges, continued for nearly three hours.

Senator Shortridge, of California, told the Senate that after the extended and painstaking investigation which he conducted on behalf of the Senate, there was nothing disclosed to indicate that there is anything even approaching a monopoly in the domestic dye industry. In announcing his forthcoming report on the subject, Senator Shortridge addressed himself to Senator King and stated that, in making his conclusions, he would not rely upon rumor, and that he would not draw upon his imagination.

### Sentiment in Favor of Embargo

The principal address presenting arguments in favor of the embargo was that of Senator Frelinghuysen, who took the floor at the end of Senator Moses' speech. He prefaced his remarks by stating that his speech had not been prepared for him by some one entirely familiar with these technical questions. The theme of his address is well set forth in the following brief extract:

"My fight for a dye embargo and my insistence upon its continuance is based upon two motives — first, to protect and continue the industry in my state and secondly, because I believe it is absolutely essential for the national defense, as I read the history of the war and what was accomplished by Germany by reason of her advanced position in chemical manufacture. This is a great question for the Senate to decide at this time. The only harm that will come from a dye embargo is to the German industries — the German cartel that furnished Germany with all her chemicals and ammunition during the war. If we make a mistake now and lift this embargo, it may destroy, and probably will destroy, this great industry, which was created during the war by the men of energy and genius who had the courage and the ability quickly to provide our armies with the necessary materials with which to meet the onslaught of Germany.

"There is just one question involved. Inasmuch as the former President of the United States, Mr. Wilson, recommended the embargo, since President Harding has recommended its continuance, and every Cabinet officer and military officer who is familiar with the situation and every man who has studied it makes similar recommendations, the question which we have to decide as to its continuance is whether we are going to stand for America first or for 'Deutschland uber Alles'."

Before the vote was taken, Senator McCumber made the following statement:

"The only question before the Senate is the question of the embargo upon dyestuffs. On that subject there was a disagreement in the committee itself. One thing we do know, that prior to 1914 a foreign nation, a foreign people, furnished practically all the dyestuffs for American manufacturers.

One thing we do know and that is that after we were engaged in the war we found ourselves entirely cut off, or almost entirely cut off, from the dye products. We found, in addition, that we had to pay many times the pre-war value of our dye products. We then came to the conclusion that it was necessary to develop the dye industry in the United States. The previous administration inaugurated the idea of the use of the licensing system for the development of the dye industry. We followed along that pathway and along the previous idea of the Democratic administration and in our emergency tariff law we provided for an embargo. How long the embargo should continue is, after all, a question to be determined by the Senate. We agreed that it should be continued for another year. We know that as a rule, notwithstanding the embargo, the prices of dyes have gradually gone down from the highest peak until now they are only about 50 per cent of the high prices of 1917.

It may be with the protection we have given them, the dye people will be able to continue to produce but, Mr. President, I think in some instances they will not be enabled to continue the production without the embargo for a brief length of time. That, after all, is the only question before the Senate today, not the trial of the Chemical Foundation but the determination whether or not we desire to continue the dye industry in the United States and whether or not the duties that we imposed are sufficient, and if not sufficient for a space of one year, whether we had better maintain the present embargo. To that subject I wish we could direct our attention rather than to be misled and drawn away from the real question by a trial of a matter which is not before the Senate."

## Society of Industrial Engineers To Meet in New York

The next national convention of the Society of Industrial Engineers will be held in New York City, Oct. 18, 19 and 20 at the Hotel McAlpin. In conjunction with the 3-day convention there will be an exhibition of labor-saving equipment. The business meetings will be held in the ball room of the hotel and the exhibition in the Winter Garden.

The official program and the list of speakers and their topics will not be ready for distribution before the middle of September. The general topic of discussion, however, will be "The Economics of Industry."

## Standard Oil Co. Called Monopoly but Proof Against Law

The Federal Trade Commission has sent to Congress a report on conditions in the petroleum trade in Wyoming and Montana. This report summarizes the important facts developed through an inquiry into the conditions of the petroleum trade in those states made pursuant to a complaint of the Montana State Railway Commission regarding gasoline prices.

The margins between the wholesale and retail gasoline prices at numerous points in Montana ranged from 5 to 10 cents per gallon, but these unusually large margins were in all cases obtained only by the smaller retailers. The wholesale and retail prices of the large marketing companies were usually identical at points taking the same freight rates and price changes were made by them at practically the same time. No evidence was found, however, which indicated a conspiracy among these large companies to fix prices.

Although the prices of high-grade crude petroleum were lower in Montana and Wyoming than in any other crude-producing states in the country, the refinery prices of gasoline and kerosene were much higher than at Mid-Continent refineries. The Midwest Refining Co. is owned by the Standard Oil Co. of Indiana and produces more than 90 per cent of the gasoline and kerosene refined in the entire Rocky Mountain territory. The Midwest Refining Co. also charges higher prices for gasoline shipped into Montana and adjoining Rocky Mountain states than for shipments made in states adjacent to the Mid-Continent oil field.

The unsatisfactory situation in Montana and adjacent Rocky Mountain states is evidently due to the fact that the oil trade in this region is practically monopolized by Standard Oil interests. This monopolistic position was perfected in 1920 and 1921, when the Standard Oil Co. of Indiana secured control of the Midwest Refining Co. and acquired a one-half interest in the Sinclair Pipe Line Co. and the Sinclair Crude Oil Purchasing Co. Sinclair interests have recently obtained important leases in the Teapot Dome of the Salt Creek field in Wyoming.

The conditions in other sections of the country are not radically different from those in the Rocky Mountain region. Today the entire country is divided into 11 Standard gasoline marketing territories in which a Standard marketing company is the dominating factor and in which there is no real competition between the various Standard units. This monopolistic situation is possible under the terms of the Standard Oil dissolution decree, by which the different Standard companies are, for legal purposes, supposed to be strangers to each other, but, there is, as is generally known, an interlocking stock ownership in the different organizations which has perpetuated the very monopolistic control which the Court sought to terminate.

The Commission is of the opinion that this situation cannot be effectually remedied by existing laws and that adequate relief can only be secured through additional legislation. It recommends, therefore, that Congress pass a law prohibiting common stock ownership in corporations which have been members of a combination dissolved under the Sherman law.

## Electrochemists Organize to Stir Public Interest

On June 29 the local committee which so successfully handled the recent meeting of the American Electrochemical Society in Baltimore met for luncheon at the Hotel Emerson and decided to make the committee a permanent organization with the following objects:

1. To promote good fellowship among its members.
2. To arouse interest among the public at large in things electrochemical.
3. To act as an informal clearing house on electrochemistry with a view to attracting new electrochemical industries where possible to the Baltimore district.

W. H. Boynton, analytical chemist of the Crown Cork and Seal Co., was made permanent chairman. Other members are Ernest B. Miller, operating vice-president of the Davison Chemical Co.; F. M. Boyles, McCormick & Co.; Richard K. Meade, consulting chemical and industrial engineer of Richard K. Meade and Co.; A. E. Marshall, consulting engineer; C. C. Thomas, Williams and Wilkins Co.; W. C. Moore, research chemist of the U. S. Industrial Alcohol Co.; A. L. Browne, chemist; S. T. Powell; W. H. Stone, *Manufacturers' Record;* E. W. Rouse, assistant superintendent, Baltimore Copper Smelting and Rolling Co.; R. G. Gerhardt and R. H. Tillman, manager, new business department, Consolidated Gas, Electric Light and Power Co.

## Citro Chemical Co. Wins Case

The Citro Chemical Co. has been upheld by the United States Court of Customs Appeal in its abandonment of a shipment of 168 casks of citrate of lime which had been damaged by sea water while en route from Messina. The law provides that notice of abandonment must be filed within ten days after the entry of merchandise. The invoice and the declaration were filed a month in advance of the arrival of the shipment. Since the declaration contains the perfunctory statement that the merchandise has arrived, it was contended that the chemical company could not have recourse to abandonment. The court holds however, that the actual date of entry must govern and since the notice was filed within ten days after the actual entry of the ship carrying the merchandise, the chemical company's contention must be sustained.

## A.C.S. Alcohol Committee Secures Government Support

Martin H. Ittner, chief chemist of Colgate and Co., of New York, chairman of the Industrial Alcohol Committee of the American Chemical Society has announced that Wayne B. Wheeler of the Anti-Saloon League has assured him that the League will not attempt any new restrictions without first consulting the A. C. S. Alcohol Committee.

Dr. Ittner's Statement follows:

The Industrial Alcohol Committee believes in a literal interpretation of the 18th Amendment, also that no authority is conferred thereby to prohibit the manufacture, sale, transportation, importation, or exportation of intoxicating liquors for other than beverage purposes.

The main thing that the Committee on Industrial Alcohol is interested in and a thing that we are vitally interested in, is that there shall be no prohibition of alcohol either pure or in liquors where it is intended to be used for other than beverage purposes, i. e., for industrial and legitimate uses.

We recognize the necessity of laws and regulations to control these matters and we desire to see these laws and regulations as little burdensome as possible while accomplishing their proper purpose. We stand ready to give what aid we have, or can enlist, to the support of the Government in advising them with regard to laws or regulations that would prohibit or unduly restrict the proper use of alcohol.

Mr. Wayne B. Wheeler, counsel for the Anti-Saloon League, has assured me that they would not seek to pass any new laws or have any new restrictive regulations drawn up without first seeking our advice and that of representatives of the industries.

The trouble with the national prohibition act is in its improper enforcement. Title III which provides for the industrial use of alcohol, though equally as important as other portions of the law, has not been given the attention and recognition by enforcement officers that it should have had and to this extent industry has suffered.

The prohibition forces ought to see that every unnecessary restriction imposed on industry reacts through public opinion against them.

The statement also points out the undisputed right of Congress to regulate intoxicating liquors.

## Progress in Investigation of Fluorspar Industry

The general investigation of fluorspar mining, milling and utilization problems is progressing rapidly through the field work of R. B. Ladoo, Bureau of Mines. Mr. Ladoo has completed field studies in the West and within a short time will have visited the eastern deposits of this mineral. It is planned to gather very complete information regarding methods of utilization of fluorspar and the specifications and requirements as to quality of this material.

## Poison Gas Officially Tabooed by Army

### War Department Orders Discontinuance of Manufacture Except for Research and Defense

The War Department's interpretation of the gas treaty adopted by the arms conference provides for the discontinuance of the manufacture of poison gas except in limited amounts for research and development of defense appliances. The definite announcement took the form of a general order signed by General Pershing as Chief of Staff, by direction of Secretary Weeks. The order follows:

> In order that the United States may carry out the provision contained in Article V of the treaty in relation to the use of submarines and noxious gases in warfare, signed, Feb. 6, 1922, and ratified by the United States Senate, March 28, 1922, the following limitations will be observed in connection with the procurement, design research, development and supply to cehmical warfare materials as given in Section III, General Orders No. 54, War Department, 1920.
>
> The investigation, development, procurement, manufacture, or supply of poisonous gases for the present will be limited strictly to the amount necessary for the research and development of gas-defense appliances.
>
> The filling of all projectiles and containers with poisonous gas will be discontinued, except for the limited number needed in perfecting gas-defense appliances.

MODIFICATIONS IN TRAINING

Another modification of existing regulations concerning the training of the army in chemical warfare was provided in another order confirming the use of smoke, incendiary materials and non-toxic gas for training and gas-defense appliances.

This order then directs that there shall be a special service school at which specified officers and non-commissioned officers of the army and the National Guard shall be trained. Provision is made for chemical warfare personnel as instructors in defensive chemical warfare at general service schools and at certain special service schools, and for representation on the staffs of departments, corps areas and divisions.

FUNDS AVAILABLE TO C. W. S.

The War Department appropriation bill which has been passed by Congress and approved by the President authorizes construction work at Edgewood Arsenal to cost $262,000. For administrative expense the Chemical Warfare Service is allowed $17,240 and $600,000 for investigations.

## New Potash Fertilizer

A new potash fertilizer has recently been introduced in Sweden under the name "Electrokali." The material is the finely-ground slag from the electric-furnace manufacture of ferro-silicon from feldspar and iron turnings.

## Salt Producers Association Restrained from Price Fixing

The Federal Trade Commission has issued an order to cease and desist against The Salt Producers Association, of Detroit, and the following members thereof: Michigan Salt Association, of Saginaw, Mich.; Michigan Salt Works, of Marine City, Mich.; International Salt Co. of New York, Scranton, Pa.; Worcester Salt Co., of New York City; The Colonial Salt Co., of Akron, Ohio; Morton Salt Co., of Chicago, Ill.; Ohio Salt Co., of Wadsworth, Ohio; Diamond Crystal Salt Co. of St. Clair, Mich.; Cutler Magner Co., of Duluth, Minn.; Union Salt Co., of Cleveland, Ohio; Stearnes Salt & Lumber Co., of Ludington, Mich.; Carey Salt Co. and Barton Salt Co., of Hutchinson, Kansas; and Mulkey Salt Co., Inland-Delray Salt Co., D. B. Doremus, all of Detroit, Mich.; Anthony Salt Co., of Anthony, Kansas.

The order prohibits the respondents from entering into any agreement or understanding among themselves to use any list of jobbers, wholesalers or other dealers in salt as a basis for allowance of jobbers' and wholesalers' prices and terms. The respondents are also ordered not to restrict, through concerted agreement, the number of purchasers who shall receive recognition as jobbers or wholesalers and not to refuse to sell, through agreement, to anyone not classified or listed as a jobber or wholesaler by any agency, publisher or person.

The complaint against The Buckley & Douglas Lumber Co., of Manistee, Mich., also a member of The Salt Producers Association, has been dismissed by the Commission upon its own motion.

## Experiment with Silica Gel for Oil Refining

The Davison Chemical Co. has started operation of the experimental plant at Curtis Bay, Ind., for the study of silica gel in crude oil refining. The unit has a capacity of 40 barrels per day. The primary purpose of the installation is to study the cost of refining with silica gel. A number of oil companies have agreed to send carload shipments of oil for experiments. The present equipment at the plant provides only for the production of gasoline and kerosene but it is planned to extend the work to lubricating oils as the experiments progress.

## Personal

E. F. BRUNDAGE, manager of the Baltimore branch office of the General Chemical Co. and superintendent of the plant, resigned to join the staff of Wing & Evans, Inc., agents for the Solvay Process Co. C. S. BENJAMIN has been appointed superintendent and acting manager at Baltimore, succeeding Mr. Brundage.

H. KENYON BURCH, who designed and built concentrating plants for the Inspiration Consolidated Copper Co., Miami Copper Co., Phelps, Dodge Corporation, and others, has opened offices at 806 Junion Orpheum Building, Los Angeles, Cal., and will design and construct a 5,000-ton concentrating plant for the New Cornelia Copper Co., at Ajo, Ariz.

E. L. DOHENY, chairman of the board of the Mexican Petroleum Co., has left New York for Los Angeles, Cal., where he will remain for a number of weeks.

V. L. HAVENS, editor of *Ingeniería Internacional*, expects to sail August 5, for South America, to attend the International Engineering Congress in Rio de Janeiro in September. He will probably visit also in Uruguay, Argentina and some other South American countries and will be gone for several months.

GEORGE B. HOGABOOM has resigned from the research department of the Scovill Manufacturing Co., Waterbury, Conn., to become a partner in Bennet & Seeley, Inc., Bridgeport, Conn., jobbers in foundry, electro-plating and finishing department supplies and equipment. Mr. Hogaboom expects to assist on electroplating engineering problems.

PAUL D. V. MANNING has severed his connection with the International Coal Products Corporation and has taken a position as chemical engineer with the Bregeat Corp. of America, 2 Rector Street, New York City.

T. B. PRESTON of Ionia, Mich., has been elected president of the Charles F. Noble Oil and Gas Co., Tulsa, Okla., succeeding Charles F. Noble.

H. B. PRIOR has been appointed New York representative for the G. T. Banker Chemical Co., Phillipsburg, N. J., with headquarters at 17 East 42nd Street, New York City.

G. N. SCHRAMM has been appointed on the chemical staff of the Bureau of Standards to assist in the work of the battery and electrochemical section. He will be engaged on various research problems under the general direction of George W. Vinal, chief of this section of the Bureau.

E. G. SIEVERS, who has been in charge of the U. S. Geological Survey statistical and geologic work on natural gas and natural-gas gasoline, has been transferred from the Survey to be an assistant valuation engineer in the Oil and Gas Section of the Bureau of Internal Revenue. Mr. Sievers began work in his new position on July 10.

## Obituary

EDWARD R. CALDWELL, president of the Syracuse Rubber Co., Syracuse, N. Y., died July 6 at his residence. He was the founder of the Caldwell & Ward Brass Co. and for many years was head of the E. R. Caldwell & Son Brass Co. He was one of the founders of the Syracuse Rubber Co., which manufactures rubber tires.

# Market Conditions

## IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

**A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers**

## The Recent Trend of Wholesale Commodity Prices

### Closing Up the Spreads Between the Great Groups of Commodities—Further Advances Predicted by Business Cycle Students

SINCE January there has been an upward swing in general wholesale prices which has done much to correct the maladjustment in the price levels of individual commodities. During 1921 the free interchange of commerce had been considerably restricted by the false relations between the prices for the products of the different industrial groups. The higher prices for agricultural and food products, metals and other basic materials of commerce have greatly improved although not entirely eliminated this unfavorable economic condition.

The newly revised index number of the Federal Bureau of Labor Statistics for all commodities, about which we shall have more to say later, has risen from 138 in January, 1922, to 148 for May. Farm products have shown a similar gain of 10 points and foods, fuel and building materials have all recorded improvement. Bradstreet's monthly index during the past thirteen months has advanced eleven times and decreased only twice and then to a minor extent. Dun's index, too, has steadily risen during the past eleven months. *Chem. & Met.'s* weighted index of chemical prices, which stood at 143.30 on January 1, 1922, averaged 157.48 for the month of June and 154.65 for the past week.

That the upward trend of wholesale commodity prices will continue for several months at least is the conclusion drawn by the Harvard Economic Service from a study of price movements over a number of years. This is confirmed, they believe, by the fact that "fundamental economic conditions are still favorable to continued price advance."

The Harvard Service's curve which is reproduced in Fig. 2, is based on their ten-commodity index, which started its upward movement last September and since April has risen steadily. The Harvard forecast for continued price advance is based on the following data and conclusions:

> There have been four major upswings in prices from 1900 to 1913. These movements are shown in the accompanying chart (Fig. 2) where the ten-commodity index is plotted for this period. The first rise begin in January, 1901, and lasted for 21 months, the second commenced in September, 1904, and continued for 30 months; the third started in September, 1908, and terminated 14 months later; and the fourth continued for 14 months beginning in November, 1911. Thus the minimum duration of price advance was 14 months.
>
> The index number of the Bureau of Labor Statistics shows even longer periods of advance. Beginning in June, 1901, the upward movement continued for 20 months; the next advance started in October, 1904, and lasted for 36 months; the third upward movement commenced in August, 1908, and lasted for 19 months; the last advance during the period considered began in May, 1911, and lasted for 29 months. When we consider that the present rise of prices has been under way for only 10 months, according to the ten-commodity index, the evidence from former business cycles points definitely to a continuance of the present upward movement.

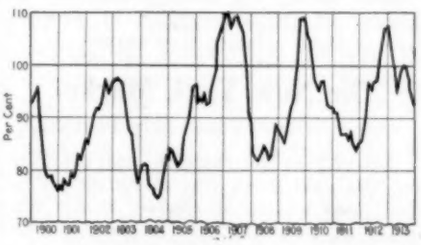



FIG. 2—HARVARD ECONOMIC SERVICE'S TEN-COMMODITY INDEX, 1900-1913

### The Revised Index Numbers

As reported in our issue of July 5 the Bureau of Labor Statistics has recently announced a complete revision of its series of index numbers showing changes in the level of wholesale prices. This revision consists of (1) a regrouping of the commodities and the addition of a considerable number of new articles and (2) the use of the 1919 census data for weighting purposes in place of the 1919 census data formerly employed.

In preceding reports the Bureau confined an article to a particular group regardless of its fitness for inclusion also under other group designations. Under the new plan, articles properly falling under more than one of the classifications adopted are to be included under each classification. In computing the general index number

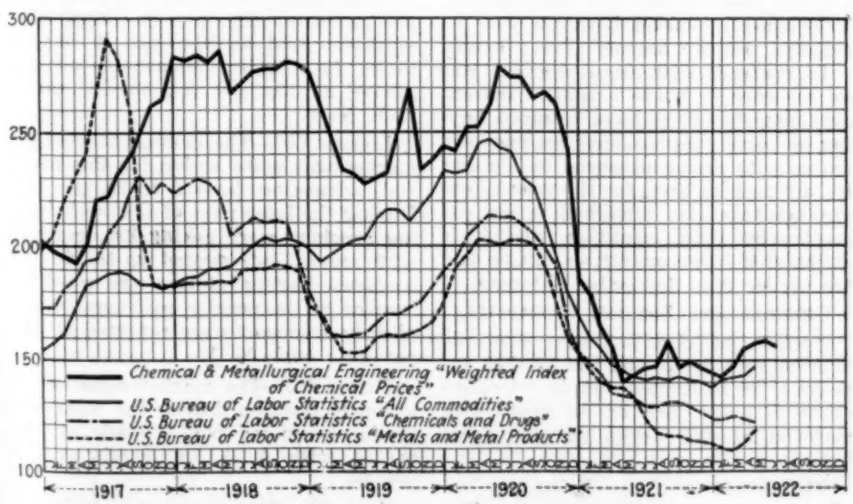



FIG. 1—"CHEM. & MET.'S" INDEX OF CHEMICAL PRICES AND THE U. S. BUREAU OF LABOR STATISTICS' REVISED INDEX NUMBERS, 1917-1922

### "Chem. & Met." Weighted Index of Chemical Prices

*Base = 100 for 1913-1½*

| | |
|---|---|
| This week | 154.65 |
| Last week | 156.67 |
| July, 1921 | 148 |
| July, 1920 | 274 |
| April, 1918 (high) | 286 |
| April, 1921 (low) | 140 |

The decided drop in this week's index number is almost entirely attributable to the lower prices for cottonseed oil. Formaldehyde also declined—to the lowest level since the war—and so did caustic soda. The only increases were for linseed oil and acetic acid.

TABLE I—REVISED INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES, AND BY MONTHS, SINCE JANUARY, 1922.
*1913 EQUALS 100*

| 1922 | Farm Products | Foods | Cloths and Clothing | Fuel and Lighting | Metals and Metal Product | Building Materials | Chemicals and Drugs | House Furnishing Goods | Miscellaneous | All Commodities — New Index | All Commodities — Old Index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. | 122 | 131 | 176 | 195 | 112 | 157 | 124 | 178 | 117 | 138 | 148 |
| Feb. | 131 | 135 | 174 | 191 | 110 | 156 | 123 | 177 | 117 | 141 | 151 |
| Mar. | 130 | 137 | 172 | 191 | 109 | 155 | 125 | 175 | 117 | 142 | 152 |
| Apr. | 129 | 137 | 171 | 194 | 113 | 156 | 124 | 175 | 116 | 143 | 152 |
| May | 132 | 138 | 175 | 216 | 119 | 160 | 122 | 176 | 116 | 148 | ... |

for all commodities, however, such articles will be counted only once, in order to avoid duplication in the final result.

Table I gives the revised index numbers for the several commodity groups from January to June of the current year. For comparison with the new series, the old general index of all commodities is shown in the last column.

### Weighting of Chemicals

The former index number for the group "Chemicals and Drugs" was based on the wholesale prices in New York for acetic acid, muriatic acid, nitric acid, sulphuric acid, grain alcohol, wood alcohol, lump alum, anhydrous ammonia, borax, copper sulphate, refined glycerine, opium, quinine, carbonate of soda, caustic soda, nitrate of soda, soda ash and crude sulphur. To show the great number of additions made in connection with the current revision as well as relative weightings given the individual commodities, Table II is appended.

The weighting factors are taken from the 1919 census, supplemented in some instances by information from other government sources and from trade associations. In each case the figures represent, as nearly as can be determined, the quantity of the article sold in the markets in 1919. For commodities represented by more than one series of price quotations, the total quantity marketed has been apportioned among the several markets or grades of the commodity in proportion to their relative importance.

TABLE II. WEIGHTING FACTORS USED BY BUREAU OF LABOR STATISTICS IN CONSTRUCTING ITS INDEX NUMBERS FOR "CHEMICALS AND DRUGS"

| Commodity | Unit | Weighting Factor—(000 omitted) |
|---|---|---|
| (a) *Chemicals*: | | |
| Acids, New York— | | |
| Acetic, 28 per cent | lb. | 53,084 |
| Muriatic, 20 deg. | lb. | 294,260 |
| Nitric, 42 deg. | lb. | 38,880 |
| Stearic, triple pressed | lb. | 16,970 |
| Sulphuric, 66 deg. | lb. | 6,592,540 |
| Alcohol, New York— | | |
| Denatured, No. 5, 188 proof | gal. | 60,399 |
| Wood, refined, 95 per cent | gal. | 6,985 |
| Alum, lump, New York | lb. | 654,000 |
| Ammonia, anhydrous, New York | lb. | 54,700 |
| Bleaching powder, New York | cwt. | 1,771 |
| Borax, crystals and gran., N. Y. | lb. | 42,870 |
| Copper sulphate, 99 per cent, crystals, N. Y. | lb. | 35,288 |
| Copra, South Sea, sun dried, N. Y. | lb. | 98,561 |
| Formaldehyde, New York | lb. | 19,664 |
| Oil, vegetable— | | |
| Coconut, crude, Pacific Coast | lb. | 244,325 |
| Corn, crude, in barrels, New York | lb. | 13,636 |
| Palm kernel, crude, New York | lb. | 41,564 |
| Soya bean, crude, in barrels, N. Y. | lb. | 88,987 |
| Potash, caustic, 88-92 per cent, N.Y. | lb. | 12,625 |
| Sal soda, New York | cwt. | 1,437 |
| Soda ash, 58 per cent, light, N. Y. | cwt. | 20,670 |
| Soda, bicarbonate, Amer., f.o.b. wks. | lb. | 283,120 |
| Soda, caustic, 76 per cent solid, N.Y. | lb. | 638,980 |
| Soda, silicate of, 40 deg. N. Y. | cwt. | 5,736 |
| Sulphur, crude, New York | gross tons | 678 |
| Tallow, inedible, packers' pr., Chicago | lb. | 263,951 |
| (b) *Fertilizer materials*: | | |
| Acid phosphate, 16 p.c., bulk, N.Y. | tons | 3,680 |
| Ammonia, sulphate, dbl. bags, N.Y. | cwt. | 5,950 |
| Ground bone, steamed, Chicago | tons | 60 |
| Muriate of potash, 80-85 per cent, bags, New York | tons | 21 |
| Phosphate rock, 68 per cent, f.o.b. mines | tons | 2,272 |
| Soda nitrate, 95 per cent, New York | cwt. | 8,978 |
| Tankage, 9 and 20%, crushed, f.o.b. Chicago | tons | 297 |
| (c) *Drugs and pharmaceuticals*: | | |
| Acid, citric, domestic, crystals, N.Y. | lb. | 3,164 |
| Acid, tartaric, crystals, U.S.P., N.Y. | lb. | 5,313 |
| Alcohol, grain, 190 pr., U.S.P., N.Y. | gal. | 25,000 |
| Cream of tartar, powdered, N.Y. | lb. | 2,855 |
| Epsom salts, U.S.P., in barrels, N.Y. | cwt. | 587 |
| Glycerine, refined, New York | lb. | 64,343 |
| Opium, natural, U.S.P., New York | lb. | 619 |
| Peroxide of hydrogen, 4-oz. bottles, New York | gross | 875 |
| Phenol, U.S.P., New York | lb. | 64,300 |
| Quinine, sulphate, mfrs'. quo., N.Y. | oz. | 3,937 |

## The New York Market

New York, July 17, 1922.

Activity in the chemical market during the past week was along very limited lines which, of course, is not unusual at this time of the year. Producers in many items are resuming the old tactics of price cutting in a vain effort to clear out surplus stocks. A few price changes were the only features of the interval. The most important of these was the sharp cut in the price of formaldehyde to the lowest level recorded since the war. The export movement in caustic soda remained very slow and prices for standard goods were again fractionally lower. Leading factors are of the opinion that the present financial uncertainty of Germany, together with the fluctuating foreign exchange, are directly responsible for the decline. The domestic market however, was decidedly active among first hands.

In contrast with these declines was an advance in white arsenic. Insecticide manufacturers have resumed buying and spot supplies have become very scarce with prices advanced to 7¾c. per lb., a new high level for the year. Copper sulphate has remained in an exceptionally tight condition, and it is doubtful if large quantities can be had for earlier than September shipment.

### General and Special Chemicals

*Acetate of Soda*—Prices continue firm on spot goods and the market appears to be in limited supply. Dealers quote 6¼@6½c. per lb. on spot, with material at the works ranging from 5¼@6c. per lb.

*Bichromate of Soda*—Prices are reported around 6¾@7c. per lb. The general inquiry has remained somewhat dormant, with operations mostly for contract deliveries.

*Caustic Potash*—Recent German arrivals have tended to weaken the market considerably. Offerings of 88@92 per cent are heard at 5¼@5¾c. per lb.

*Caustic Soda*—Leading producers report the export market rather easy with prices around $3.55@$3.60 per 100 lb., f.a.s. July shipment. The domestic market is steady at 3¾c. per lb. for standard brands of goods. Producers report a regular call for contracts.

*Chlorate of Potash*—Imported material has been in fair demand during the past week, with prices firmly maintained at 6½c. per lb. Domestic producers quote 8c. per lb., f.o.b. works.

*Formaldehyde*—Market inactivity in this product are the direct cause of sharp price reductions among large producers. In some quarters as low as 7½c. per lb. was heard. The resale market for spot goods was held around 8c. per lb.

*Fusel Oil*—Factors in the crude product quote $1.45@$1.50 per gal. The refined grade is held around $2.25@$2.50 per gal.

*Epsom Salt*—U. S. P. heavy spot stocks of imported material are keeping second-hand figures down around $1.85@$2.00 per 100 lb. Producers quote prices around 2½c. per lb. Demand is moderate for small lots.

*Oxalic Acid*—The market among resale merchants is held in a firm position, with moderate quantities sold at 14¾c. per lb. Producers quote limited amounts at 14½@14¾c. f.o.b. works.

*Prussiate of Soda*—Imported spot goods were reported lower with quotations ranging from 20½@21c. per lb. Small lot trading was the only feature of the market with the general tone rather unsteady.

### Vegetable Oils

*Cottonseed Oil*—The market was subjected to severe pressure when the crude material fell off considerably. Trading was active at the low figure, many buyers taking immediate advantage of the saving. Crude oil for immediate shipment from the Southeast was quiet at 8½c. per lb. September shipment sold at 8¼c. per lb buyers' tanks, f.o.b. mills. Bleachable oil was offered at 10c. per lb., buyers' tanks, f.o.b. N. Y.

*Linseed Oil*—The general tone of the market was quite active for this material, advancing from 1 to 2c. per gal. During the later part of the week leading crushers were asking 89c. per gal. with several lots quoted up to 90c. A moderate buying interest was noted for foreign oil in nearby positions. Sales of July shipment were reported at 82c. per gal., c.i.f. N. Y.

*Castor Oil*—The market remained in a steady position during the week and producers quoted No. 3 grade at 11c. per lb. with A. A. in barrels at 12c. per lb.

*Corn Oil*—The market for crude material in barrels was unchanged at 11¼@11½c. per lb. The demand was rather quiet.

## The Chicago Market

CHICAGO, July 13, 1922.

The industrial chemical market showed but little change during the past two weeks except for a slightly firmer tone. Buying continued to be on a hand-to-mouth basis although repeat orders were reported to be more numerous. The railroad strike has had but little effect on the market, as freight is apparently moving as before. Prices are rapidly becoming more stable and with a few exceptions there was but little cutting. Factors in the chemical market were evidently satisfied with the volume of business they were doing and offered no complaints.

### GENERAL CHEMICALS

During the past two weeks but little change was to be noted in the general condition of the alkali market. A routine demand existed for *caustic soda* with the solid quoted at $3.85@$3.95 per 100 lb. and the ground at $4.35@$4.50, basis 76 per cent. *Caustic potash* was reported to be moving only in small parcels at 6¼c.@6½c. per lb. for the imported 88 to 92 per cent material. *Soda ash* moved in the regular channels in small or moderate quantities at $2.20@$2.30 per 100 lb. for 58 per cent material in cooperage.

*Alums* were a trifle easier with spot stocks somewhat heavier. *Ammonia alum* was quoted by importers or their agents at 3¾c.@4¼c. per lb. for the lump and 4¼c.@4¾c. for the powdered. *Potash alum* was unchanged at 4½c.@5c. per lb. for the iron free lump and 5½c.@6c. for the U. S. P. powder. *Sal ammoniac* was quiet and only small lots moved at 7¾c.@8c. per lb. on the white granular. Barium compounds were firm and domestic makers were in a position to deliver ordinary lots at once. *Barium carbonate* was rather quiet with small supplies available at 5c.@5½c. per lb. *Barium chloride* was in better demand and was offered at $95@$110 per ton. *Copper sulphate* continued firm and scarce with only small supplies available at 6½c.@7c. per lb. *Carbon bisulphide* was very active and scarce although today supplies were reported to be larger. Dealers were asking 7c.@7½c. per lb. for small or moderate lots. *Carbon tetrachloride* was rather slow and supplies were heavy. Large drums were available at 10c.@10½c. per lb. *Formaldehyde* was dull with stocks moving very slow at 9c. per lb. for single barrels. *Furfural* lacked quotable change at 35c. per lb. for 1,000 lb. lots or over.

*Glycerine* was rather easy with refiners quoting c.p. material in drums at 15c. per lb. *Red phosphorus* enjoyed a fair demand and was quoted by second hands at 26c.@30c. per lb. for case lots.

*Bichromates* were dull and unchanged with weak holders ready to cut prices for any business in sight. *Potassium bichromate* was available at 11c. per lb. in single cask lots and similar quantities of the soda at 8½c.@9c. *Red prussiate of potash* was still very scarce with broken lots quoted at 90c.@$1 per lb. *Yellow prussiate of potash* was easier and supplies were more plentiful at 32c.@35c. per lb. *Potash permanganate* was weaker with supplies of foreign material very plentiful at 15½c.@16c. per lb. for U. S. P. small crystals. *Hyposulphite of soda* moved in a routine way to the consuming trade at $3.85 per cwt. for the pea crystals in barrels. *Zinc chloride* was quoted lower at 6½c.@7c. per lb. for the granular.

Linseed oil was reported by a prominent factor to be moving very well to the consuming trade. The boiled oil was quoted late today at $1.03 per gal. in single drum lots with similar quantities of the raw at $1.01.

*Turpentine* was reported to be moving slowly and one factor advised his customers to hold off if at all possible as lower prices were expected. Single drum lots were quoted today at $1.31 per gal. but the movement was very light.

---

## The Iron and Steel Market

PITTSBURGH, July 14, 1922.

While the finished steel markets are quieter, as to actual tonnage turnover, the general standing of the market, particularly as to prices, appears to be firmer on account of the fresh menaces to production that have developed in the past week or two. It may be considered objectionable that the strength of the market should be in inverse ratio to the efficiency with which the plants operate, but conditions have to be taken as they are found.

Before the railroad shopmen's strike began July 1 there was congestion at several points where large tonnages of non-union coal were to be moved, and this condition has since been accentuated, presumably chiefly on account of the strike. Large quantities of both West Virginia and Kentucky coal, much of it consigned to byproduct coking plants, have accumulated. Coal has become much scarcer, but the increased scarcity is to be attributed chiefly to railroad conditions, not to the coal strike.

### STEEL PRODUCTION

Prospects are that unless there is a great improvement very soon in fuel supplies the production of pig iron and steel will be curtailed from the rate recently prevailing. This rate, moreover, has not been altogether as great as has been estimated recently, it being necessary, in the light of later reports, to revise estimates. The rate of steel ingot production was about 35.500,000 tons a year in April, 36,400,000 tons in May and 36,600,000 tons in June. There had been a sharp increase in production in the first three months of the year but since April 1, when the coal strike started, there has been very little increase.

The Steel Corporation's unfilled obligations increased by 602,769 tons in April, 157,311 tons in May and 381,403 tons in June. Shipments were at about 70 per cent of capacity in April and 75 per cent in both May and June. Thus bookings were much heavier in June than in May. The total of unfilled obligations at the end of June was 5,635,631 tons, but the actual figure sometimes means practically nothing as to operating prospects, the point being whether the tonnage is in contracts or in actual shipping orders. June 30, 1921, the unfilled obligations amounted to 5,117,868 tons, or only a trifle less than at present, but the corporation operated at only 25 per cent in July. Now it is operating at about 75 per cent and its shipping orders would call for a still higher rate. In actual orders the corporation is sold up for about three months.

### THE MARKET SITUATION

Neither sellers nor buyers seem disposed to commit themselves for the last quarter of the year, and thus the market in that respect cannot be regarded as either strong or weak. In the matter of early deliveries there is some demand, with little unsold steel available, and in that respect the market is in sellers' favor. However, in most lines the early deliveries are commanding premiums, bars, shapes and plates for instance being at 1.70c., 1.75c. or 1.80c., according to details of order. This gives the steel market a superficial appearance of great strength, but experience indicates that too much reliance may easily be placed upon such a showing. If the premiums come off, later, the market is made to look weaker and buyers become alarmed, while should plates, shapes and bars advance to 1.80c. as a price for any delivery buyers would in all probability consider the price too high and would start another liquidation of all stocks.

It is rather a complication that just at this time, when coke supplies, previously increasing, are menaced, pig iron should show a softening tendency in some districts. Basic iron at valley furnaces has become quotable at $24, against $25 ruling for more than two months, and southern iron is off a dollar a ton. What will come of this curious situation remains to be seen. Furnaces frankly admit that buyers are showing much less interest in pig iron than it was expected they would be showing by this time. Consumption has evidently been less than was counted upon, in the case both of foundries and of steel works that do not make their pig iron themselves.

The scrap market has been turning softer in the past fortnight in several districts. The theory in the scrap market for two or three months past has been that scarcity of coke makes for higher scrap prices, by both blast furnaces and steel mills using more scrap. Heavy melting steel ruled strong at $17.50. delivered Pittsburgh district, during May and June, but in the past few days round lots have been offered mills at $17 without finding takers.

## General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

| | | Carlots F.o.b. N.Y. | Less Carlots F.o.b. N.Y. |
|---|---|---|---|
| Acetic anhydride | lb. | ..... – ..... | $0.38 – $0.40 |
| Acetone | lb. | $0.11 – $0.11½ | .11½– .13 |
| Acid, acetic, 28 per cent | 100 lbs. | 2.35 – 2.50 | 2.55 – 3.00 |
| Acetic, 56 per cent | 100 lbs. | 5.00 – 5.25 | 5.30 – 5.50 |
| Acetic, glacial, 99½ per cent, carboys, 100 | lbs. | 8.50 – 9.00 | .50 – 9.75 |
| Boric, crystals | lb. | .11 – .11½ | .11½– .12 |
| Boric, powder | lb. | .11 – .11½ | .11½– .12½ |
| Citric | lb. | ..... – ..... | .45 – .46 |
| Hydrochloric | 100 lb. | 1.10 – 1.20 | 1.25 – 1.70 |
| Hydrofluoric, 52 per cent | lb. | .11 – .11½ | .11 – .12 |
| Lactic, 44 per cent tech | lb. | .09½– .10 | .10½– .12 |
| Lactic, 22 per cent tech | lb. | .04 – .04½ | .04½– .05 |
| Molybdic, c.p. | lb. | 3.00 – 3.25 | 3.30 – 3.75 |
| Muriatic, 20 deg. (see hydrochloric) | .... | ..... – ..... | ..... – ..... |
| Nitric, 40 deg. | lb. | .06 – .06½ | .06½– .07 |
| Nitric, 42 deg. | lb. | .06½– .06¾ | .07 – .07½ |
| Oxalic, crystals | lb. | .14½– .14¾ | .15 – .15½ |
| Phosphoric, 50 per cent solution | lb. | .08 – .08¼ | .08½– .09¼ |
| Picric | lb. | .20 – .22 | .23 – .27 |
| Pyrogallic, resublimed | lb. | ..... – ..... | 1.65 – 1.75 |
| Sulphuric, 60 deg., tank cars | ton | 9.50 – 10.00 | ..... – ..... |
| Sulphuric, 60 deg., drums | ton | 12.00 – 14.00 | ..... – ..... |
| Sulphuric, 66 deg., tank cars | ton | 15.00 – 16.00 | ..... – ..... |
| Sulphuric, 66 deg., drums | ton | 19.00 – 20.00 | 20.50 – 21.00 |
| Sulphuric, 66 deg., carboys | ton | ..... – ..... | ..... – ..... |
| Sulphuric, fuming, 20 per cent (oleum) tank cars | ton | 19.00 – 20.00 | ..... – ..... |
| Sulphuric, fuming, 20 per cent (oleum) drums | ton | 22.00 – 22.50 | 23.00 – 24.00 |
| Sulphuric, fuming, 20 per cent (oleum) carboys | ton | 31.00 – 32.00 | 33.00 – 34.00 |
| Tannic, U. S. P. | lb. | ..... – ..... | .60 – .75 |
| Tannic (tech.) | lb. | .40 – .45 | .46 – .50 |
| Tartaric, imported crystals | lb. | ..... – ..... | .29 – .29½ |
| Tartaric acid, imported, powdered | lb. | ..... – ..... | .29½– .30 |
| Tartaric acid, domestic | lb. | ..... – ..... | ..... – .30 |
| Tungstic, per lb. of WO | lb. | ..... – ..... | 1.00 – 1.10 |
| Alcohol, ethyl (Cologne spirit) | gal. | ..... – ..... | 4.75 – 4.95 |
| Alcohol, methyl (see methanol) | .... | ..... – ..... | ..... – ..... |
| Alcohol, denatured, 188 proof No. 1 | gal. | ..... – ..... | .28 – .31 |
| Alcohol, denatured, 188 proof No. 5 | gal. | ..... – ..... | .28 – .31 |
| Alum, ammonia, lump | lb. | .03¼– .03½ | .03½– .04 |
| Alum, potash, lump | lb. | .03 – .03¼ | .03½– .04 |
| Alum, chrome lump | lb. | .05½– .05¾ | .06 – .06½ |
| Aluminum sulphate, commercial | 100 lb. | 1.50 – 1.65 | 1.70 – 2.25 |
| Aluminum sulphate, iron free | lb. | .02½– .02¾ | .03 – .03½ |
| Aqua ammonia, 26 deg., drums (750 lb.) | lb. | .06½– .07¼ | .07½– .08 |
| Ammonia, anhydrous, cyl. (100-150 lb.) | lb. | .30 – .30½ | .30½– .31 |
| Ammonium carbonate, powder | lb. | .08 – .08¼ | .08½– .09 |
| Ammonium nitrate | lb. | .06 – .06½ | .06½– .07½ |
| Amylacetate tech. | gal. | ..... – ..... | 2.00 – 2.25 |
| Arsenic, white, powdered | lb. | .07½– .08 | .08¼– .08½ |
| Arsenic, red, powdered | lb. | .12 – .12½ | .12½– .13 |
| Barium carbonate | ton | 61.00 – 63.00 | 64.00– 68.00 |
| Barium chloride | ton | 95.00 –100.00 | 105.00 –110.00 |
| Barium dioxide (peroxide) | lb. | .20 – .21 | .21½– .22 |
| Barium nitrate | lb. | .07½– .07¾ | .08 – .08½ |
| Barium sulphate (precip.) (blanc fixe) | lb. | .04 – .04½ | .04½– .04¾ |
| Blanc fixe, dry | lb. | .04 – .04½ | ..... – ..... |
| Blanc fixe, pulp | ton | 45.00 – 55.00 | ..... – ..... |
| Bleaching powder | 100 lb. | 1.60 – 1.75 | 1.85 – 2.50 |
| Blue vitriol (see copper sulphate) | .... | ..... – ..... | ..... – ..... |
| Borax | lb. | .05¼– .05½ | .06 – .06½ |
| Brimstone (see sulphur, roll) | .... | ..... – ..... | ..... – ..... |
| Bromine | lb. | .27 – .28 | .28½– .35 |
| Calcium acetate | 100 lbs. | 2.00 – 2.25 | ..... – ..... |
| Calcium carbide | lb. | .04½– .04¾ | .05 – .05½ |
| Calcium chloride, fused, lump | ton | 22.00 – 23.00 | 23.50 – 27.00 |
| Calcium chloride, granulated | lb. | .01½– .01¾ | .02 – .02½ |
| Calcium peroxide | lb. | ..... – ..... | 1.40 – 1.50 |
| Calcium phosphate, tribasic | lb. | ..... – ..... | .15 – .16 |
| Camphor | lb. | ..... – ..... | .80 – .83 |
| Carbon bisulphide | lb. | .06½– .06¾ | .07 – .07½ |
| Carbon tetrachloride, drums | lb. | .09½– .10 | .10½– .12 |
| Carbonyl chloride, (phosgene) | lb. | ..... – ..... | .60 – .75 |
| Caustic potash (see potassium hydroxide) | .... | ..... – ..... | ..... – .... |
| Caustic soda (see sodium hydroxide) | .... | ..... – ..... | ..... – ..... |
| Chalk, precip.—domestic, light | lb. | .04½– .04¾ | ..... – ..... |
| Chalk, precip.—domestic, heavy | lb. | .03½– .03¾ | ..... – ..... |
| Chalk, precip.—imported, light | lb. | .04½– .05 | ..... – ..... |
| Chlorine, gas, liquid-cylinders (100 lb.) | lb. | .05 – .05½ | .05½– .06 |
| Chloroform | lb. | ..... – ..... | .25 – .32 |
| Cobalt oxide | lb. | ..... – ..... | 2.00 – 2.10 |
| Copperas | ton | 20.00 – 22.00 | 23.00 – 30.00 |
| Copper carbonate, green precipitate | lb. | .19 – .20 | .20½– .21 |
| Copper cyanide | lb. | ..... – ..... | .58 – .60 |
| Copper sulphate, crystals | 100 lb. | 6.50 – 6.60 | 6.65 – 7.00 |
| Cream of tartar | lb. | ..... – ..... | .24 – .25 |
| Epsom salt (see magnesium sulphate) | .... | ..... – ..... | ..... – ..... |
| Ethyl acetate com. 85% | gal. | ..... – ..... | .60 – .65 |
| Ethyl acetate, pure (acetic ether, 98% to 100%) | gal. | ..... – ..... | .90 – .95 |
| Formaldehyde, 40 per cent | lb. | .07½– .07¾ | .07¾– .08 |
| Fullers earth, f.o.b. mines | net ton | 16.00 – 17.00 | ..... – ..... |
| Fullers earth—imported powdered—net | ton | 30.00 – 32.00 | ..... – ..... |
| Fusel oil, ref. | gal. | ..... – ..... | 2.25 – 2.65 |
| Fusel oil, crude | gal. | ..... – ..... | 1.45 – 1.50 |
| Glauber's salt (see sodium sulphate) | .... | ..... – ..... | ..... – ..... |
| Glycerine, c. p. drums extra | lb. | ..... – ..... | .15 – .15½ |
| Iodine, resublimed | lb. | ..... – ..... | 4.20 – 4.25 |
| Iron oxide, red | lb. | ..... – ..... | .12 – .18 |
| Lead acetate | lb. | ..... – ..... | .09½– .11½ |
| Lead arsenate, powd. | lb. | .13 – .13½ | .13½– .14½ |
| Lead nitrate | lb. | ..... – ..... | .15 – .20 |
| Litharge | lb. | .07½– .08 | .08 – .09 |
| Magnesium carbonate, technical | lb. | .06½– .07 | .07½– .08 |
| Magnesium sulphate, U. S. P. | 100 lb. | 2.00 – 2.25 | 2.30 – 2.50 |
| Magnesium sulphate, technical | 100 lb. | ..... – ..... | 1.00 – 1.80 |
| Methanol, 95% | gal. | ..... – ..... | .57 – .58 |
| Methanol, 97% | gal. | ..... – ..... | .59 – .60 |
| Nickel salt, double | lb. | ..... – ..... | .11 – .11½ |
| Nickel salt, single | lb. | ..... – ..... | .10 – .10½ |
| Phogene (see carbonyl chloride) | .... | ..... – ..... | ..... – ..... |
| Phosphorus, red | lb. | ..... – ..... | .40 – .45 |
| Phosphorus, yellow | lb. | ..... – ..... | .30 – .35 |
| Potassium bichromate | lb. | .09½– .09¾ | .10 – .10½ |
| Potassium bromide, granular | lb. | ..... – ..... | .17 – .23 |
| Potassium carbonate, U. S. P. | lb. | .12 – .12½ | .13 – .16 |
| Potassium carbonate, 80–85% | lb. | .05 – .05½ | .05½– .06 |
| Potassium chlorate, powdered and crystals | lb. | .06½– .07 | .07½– .08 |
| Potassium cyanide | lb. | ..... – ..... | .50 – .52 |
| Potassium hydroxide (caustic potash) | 100 lb. | 5.50 – 5.75 | 6.00 – 6.25 |
| Potassium iodide | lb. | ..... – ..... | 3.20 – 3.35 |
| Potassium nitrate | lb. | .06½– .06¾ | .07 – .08 |
| Potassium permanganate | lb. | .14½– .14¾ | .15 – .16 |
| Potassium prussiate, red | lb. | ..... – ..... | .90 – .95 |
| Potassium prussiate, yellow | lb. | .32 – .32½ | .32½– .33 |
| Rochelle salts (see sodium potas. tartrate) | .... | ..... – ..... | ..... – ..... |
| Salammoniac, white, granular | lb. | .06½– .07 | .07½– .08 |
| Salammoniac, gray, granular | lb. | .07½– .08 | .08½– .08¾ |
| Salsoda | 100 lb. | 1.20 – 1.40 | 1.45 – 1.60 |
| Salt cake (bulk) | ton | 20.00 –25.00 | ..... – .... |
| Soda ash, light, 58 per cent flat, bags, contract | 100 lb. | 1.65 – 1.70 | 2.00 – 2.25 |
| Soda ash, light, 58 per cent flat, bags, resale | 100 lb. | 1.75 – 1.80 | 1.85 – 2.35 |
| Soda ash, dense, in bags, resale | 100 lb. | 1.85 – 1.90 | 1.95 – 2.40 |
| Sodium acetate | lb. | .06½– .06¾ | .06¾– .07 |
| Sodium bicarbonate | 100 lb. | 1.75 – 1.85 | 1.90 – 2.30 |
| Sodium bichromate | lb. | .06½– .07 | .07½– .07½ |
| Sodium bisulphate (nitre cake) | ton | 4.50 – 4.60 | 4.65 – 5.50 |
| Sodium bisulphite powdered, U.S.P. | lb. | .04½– .04¾ | .04¾– .05½ |
| Sodium chlorate | lb. | .06½– .06¾ | .07 – .07½ |
| Sodium chloride | long ton | 12.00 –13.00 | ..... – ..... |
| Sodium cyanide | lb. | .21 – .22 | .22½– .25 |
| Sodium fluoride | lb. | .09½– .10 | .10½– .10¾ |
| Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract | 100 lb. | 3.35 – 3.50 | 3.80 – 4.00 |
| Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale | 100 lb. | 3.60 – 3.65 | –3.70 – 4.00 |
| Sodium hydroxide (caustic soda), ground and flake, contracts | 100 lb. | 3.85 – 4.00 | –4.30 – 4.50 |
| Sodium hydroxide (caustic soda) ground and flake, resale | 100 lb. | 4.00 – 4.15 | –4.40 – 4.60 |
| Sodium hyposulphite | lb. | .03 – .03½ | .03½– .04 |
| Sodium nitrite | lb. | .08 – .08¼ | .08½– .09 |
| Sodium peroxide, powdered | lb. | .28 – .30 | .31 – .35 |
| Sodium phosphate, dibasic | lb. | .03½– .04 | .04½– .04¾ |
| Sodium potassium tartrate (Rochelle salts) | lb. | ..... – ..... | .18 – .21 |
| Sodium prussiate, yellow | lb. | .20½– .21 | .21½– .21¾ |
| Sodium silicate, (40 deg. in drums) | 100 lb. | .80 – 1.00 | 1.05 – 1.25 |
| Sodium silicate, (60 deg. in drums) | 100 lb. | 2.25 – 2.40 | 2.45 – 2.75 |
| Sodium sulphate, crystals (glaubers salt) | 100 lbs. | .90 – 1.00 | 1.05 – 1.50 |
| Sodium sulphide, fused, 60-62 per cent (cone.) | lb. | .04½– .04¾ | .04¾– .05 |
| Sodium sulphite, crystals | lb. | .03½– .03¾ | .03¾– .04½ |
| Strontium nitrate, powdered | lb. | .09½– .10 | .10½– .12 |
| Sulphur chloride, yellow | lb. | .04½– .05 | .05½– .06 |
| Sulphur, crude | ton | 18.00 –20.00 | ..... – ..... |
| Sulphur dioxide, liquid, cylinders extra | lb. | .08 – .08½ | .09 – .10 |
| Sulphur (sublimed), flour | 100 lb. | ..... – ..... | 2.25 – 3.10 |
| Sulphur, roll (brimstone) | 100 lb. | 2.00 – 2.15 | 2.20 – 2.70 |
| Talc—imported | ton | 30.00 –40.00 | ..... – ..... |
| Talc—domestic powdered | ton | 18.00 –25.00 | ..... – ..... |
| Tin bichloride | lb. | .09 – .09½ | .09½– .10 |
| Tin oxide | lb. | ..... – ..... | .35 – .37 |
| Zinc carbonate | lb. | .14 – .14½ | .14½– .15½ |
| Zinc chloride, gran. | lb. | .06 – .06½ | .06½– .07 |
| Zinc cyanide | lb. | .42 – .44 | .45 – .47 |
| Zinc oxide, XX | lb. | .07½– .08 | .08½– .08¾ |
| Zinc sulphate | 100 lb. | 2.75 – 3.00 | 3.05 – 3.30 |

## Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

| | | |
|---|---|---|
| Alpha-naphthol, crude | lb. | $1.00 — $1.05 |
| Alpha-naphthol, refined | lb. | 1.10 — 1.15 |
| Alpha-naphthylamine | lb. | .30 — .31 |
| Aniline oil, drums extra | lb. | .14 — .16 |
| Aniline salts | lb. | .22 — .24 |
| Anthracene, 80% in drums (100 lb.) | lb. | .75 — 1.00 |
| Benzaldehyde U.S.P. | lb. | 1.25 — 1.30 |
| Benzene, pure, water-white, in drums (100 gal.) | gal. | .30 — .35 |
| Benzene, 90%, in drums (100 gal.) | gal. | .28 — .32 |
| Benzidine, base | lb. | .85 — .95 |
| Benzidine sulphate | lb | .80 — .85 |
| Benzoic acid, U.S.P. | lb. | .60 — .65 |
| Benzoate of soda, U.S.P. | lb. | .50 — .55 |
| Benzyl chloride, 95-97%, refined | lb. | .25 — .27 |
| Benzyl chloride, tech | lb. | .20 — .23 |
| Beta-naphthol benzoate | lb. | 3.75 — 4.00 |
| Beta-naphthol, sublimed | lb. | .50 — .55 |
| Beta-naphthol, tech | lb. | .23 — .26 |
| Beta-naphthyla mine, sublimed | lb. | 1.50 — 1.60 |
| Carbazol | lb. | .75 — .90 |
| Cresol, U. S. P., in drums (100 lb.) | lb. | .12 — .15 |
| Ortho-cresol, in drums (100 lb.) | lb. | .16 — .18 |
| Cresylic acid, 97–99%, straw color, in drums | gal. | .56 — .65 |
| Cresylic acid, 95-97%, dark, in drums | gal. | .51 — .58 |
| Dichlorbenzene | lb. | .06 — .09 |
| Diethylaniline | lb. | .65 — .70 |
| Dimethylaniline | lb. | .36 — .38 |
| Dinitrobenzene | lb. | .20 — .22 |
| Dinitroclorbenzene | lb. | .22 — .24 |
| Dinitronaphthalene | lb. | .30 — .32 |
| Dinitrophenol | lb. | .33 — .35 |
| Dinitrotoluene | lb. | .22 — .24 |
| Dip oil, 25%, car lots, in drums | gal. | .24 — .26 |
| Diphenylamine | lb. | .59 — .65 |
| H-acid | lb. | .85 — .95 |
| Meta-phenylenediamine | lb. | .95 — 1.00 |
| Monochlorbenzene | lb. | .09 — .11 |
| Monoethylaniline | lb. | 1.00 — 1.20 |
| Naphthalene crushed, in bbls. | lb. | .06 — .06¼ |
| Naphthalene, flake | lb. | .06¼— .07 |
| Naphthalene, balls | lb. | .07¼— .08 |
| Naphthionate of soda | lb. | .58 — .65 |
| Naphthionic acid, crude | lb. | .65 — .70 |
| Nitrobenzene | lb. | .10 — .12 |
| Nitro-naphthalene | lb. | .30 — .35 |

| | | | |
|---|---|---|---|
| Nitro-toluene | lb. | .15 — | .17 |
| N-W acid | lb. | 1.15 — | 1.30 |
| Ortho-amidophenol | lb. | 2.40 — | 2.50 |
| Ortho-dichlor-benzene | lb. | 2.15 — | .20 |
| Ortho-nitro-phenol | lb. | .70 — | .75 |
| Ortho-nitro-toluene | lb. | $0.10 — | $0.13 |
| Ortho-toluidine | lb. | .14 — | .18 |
| Para-amidophenol, base | lb. | 1.25 — | 1.30 |
| Para-amidophenol, HCl | lb. | 1.30 — | 1.35 |
| Para-dichlorbenzene | lb. | .17 — | .20 |
| Paranitroaniline | lb. | .75 — | .80 |
| Para-nitrotoluene | lb. | .55 — | .65 |
| Para-phenylenediamine | lb. | 1.55 — | 1.60 |
| Para-toluidine | lb. | .90 — | 1.00 |
| Phthalic anhydride | lb. | .35 — | .38 |
| Phenol, U. S. P., drums | lb. | .15 — | .15½ |
| Pyridine | gal. | 1.75 — | 2.75 |
| Resorcinol, technical | lb. | 1.30 — | 1.35 |
| Resorcinol, pure | lb. | 1.75 — | 1.80 |
| R-salt | lb. | .60 — | .70 |
| Salicylic acid, tech., in bbls | lb. | .25 — | .25½ |
| Salicylic acid, U. S. P | lb. | .26 — | .26½ |
| Solvent naphtha, water-white, in drums, 100 gal | gal. | .27 — | .32 |
| Solvent naphtha, crude, heavy, in drums, 100 gal | gal. | .14 — | .18 |
| Sulphanilic acid, crude | lb. | .24 — | .26 |
| Tolidine | lb. | 1.20 — | 1.30 |
| Toluidine, mixed | lb. | .30 — | .35 |
| Toluene, in tank cars | gal. | .25 — | .28 |
| Toluene, in drums | gal. | .30 — | .35 |
| Xylidines, drums, 100 gal | lb. | .40 — | .45 |
| Xylene, pure, in drums | gal. | .40 — | .45 |
| Xylene, pure, in tank cars | gal. | .45 — | .... |
| Xylene, commercial, in drums, 100 gal | gal. | .33 — | .35 |
| Xylene, commercial, in tank cars | gal. | .30 — | .... |

## Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

| | | | |
|---|---|---|---|
| Bayberry Wax | lb. | $0.20 — | $0.21 |
| Beeswax, refined, dark | lb. | .30 — | .32 |
| Beeswax, refined, light | lb. | .34 — | .35 |
| Beeswax, pure white | lb. | .38 — | .42 |
| Candellila, wax | lb. | .40 — | .42 |
| Carnauba, No. 1 | lb. | .40 — | .42 |
| Carnauba No. 2, North Country | lb. | .22 — | .23 |
| Carnauba, No. 3, North Country | lb. | .16½ — | .16¾ |
| Japan | lb. | .16½ — | .17 |
| Montan, crude | lb. | .04 — | .04½ |
| Paraffine waxes, crude match wax (white) 105-110 m.p. | lb. | .04¼ — | .... |
| Paraffine waxes, crude, scale 124-126 m.p. | lb. | .02¾ — | .... |
| Paraffine waxes, refined, 118-120 m.p. | lb. | .03¼ — | .03½ |
| Paraffine waxes, refined, 125 m.p. | lb. | .03¼ — | .03½ |
| Paraffine waxes, refined, 128-130 m.p. | lb. | .04 — | .04¼ |
| Paraffine waxes, refined, 133-135 m.p. | lb. | .04¼ — | .04½ |
| Paraffine waxes, refined, 135-137 m.p. | lb. | .05 — | .05½ |
| Stearic acid, single pressed | lb. | .09 — | .09½ |
| Stearic acid, double pressed | lb. | .09½ — | .09¾ |
| Stearic acid, triple pressed | lb. | .10¼ — | .10½ |

## Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

| | | | |
|---|---|---|---|
| Rosin B-D, bbl | 280 lb. | $5.45 — | $5.85 |
| Rosin E-I | 280 lb. | 5.95 — | 6.35 |
| Rosin K-N | 280 lb. | 6.45 — | 7.55 |
| Rosin W. G.-W. W | 280 lb. | 7.65 — | 8.30 |
| Wood rosin, bbl | 280 lb. | 6.25 — | .... |
| Spirits of turpentine | gal. | 1.18 — | 1.20 |
| Wood turpentine, steam dist | gal. | .85 — | .... |
| Wood turpentine, dest. dist | gal. | .70 — | .70 |
| Pine tar pitch, bbl | 200 lb. | ..... — | 6.00 |
| Tar, kiln burned, bbl. (500 lb.) | bbl. | ..... — | 9.50 |
| Retort tar, bbl | 500 lb. | — | 9.00 |
| Rosin oil, first run | gal. | .36 — | ..... |
| Rosin oil, second run | gal. | .38 — | ..... |
| Rosin oil, third run | gal. | .46 — | ..... |
| Pine oil, steam dist., sp.gr., 0.930-0.940 | gal. | | 1.00 |
| Pine oil, pure, dest. dist | gal. | | .95 |
| Pine tar oil, ref., sp.gr. 1.025-1.035 | gal. | | .46 |
| Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla | gal. | | .35 |
| Pine tar oil, double ref., sp.gr. 0.965-0.990 | gal. | | .75 |
| Pine tar, ref., thin, sp.gr., 1.080-1.960 | gal. | | .25 |
| Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990 | gal. | | .25 |
| Pinewood creosote, ref | gal. | | .52 |

## Fertilizers

| | | | |
|---|---|---|---|
| Ammonium sulphate, f.a.s., N. Y., double bags | 100 lb. | 3.45 — | 3.50 |
| Blood, dried, f.o.b., N. Y | unit | 3.50 — | 3.60 |
| Bone, 3 and 50, ground, raw | ton | 32.00 — | 35.00 |
| Fish scrap, dom., dried, f.o.b. works | unit | 3.10 — | 3.20 |
| Nitrate of soda | 100 lb. | 2.50 — | 2.60 |
| Tankage, high grade, f.o.b. Chicago | unit | 3.10 — | 3.20 |
| Phosphate rock, f.o.b. mines, Florida pebble, 68-72% | ton | 3.50 — | 3.75 |
| Tennessee, 78-80% | ton | 7.00 — | 7.50 |
| Potassium muriate, 80% | ton | 33.50 — | 34.00 |
| Potassium sulphate | unit | 1.00 — | ..... |

## Crude Rubber

| | | | |
|---|---|---|---|
| Para—Upriver fine | lb. | $0.18¾ — | .19 |
| Upriver coarse | lb. | .13 — | .13¼ |
| Upriver caucho ball | lb. | .13¼ — | .13½ |
| Plantation—First latex crepe | lb. | .14¾ — | .15 |
| Ribbed smoked sheets | lb. | .14¾ — | .15 |
| Brown crepe, thin, clean | lb. | .13¾ — | .... |
| Amber crepe No. 1 | lb. | .14 — | .... |

## Oils

### VEGETABLE

The following prices are f.o.b. New York for carload lots.

| | | | |
|---|---|---|---|
| Castor oil, No. 3, in bbls | lb. | $0.11 — | $0.11½ |
| Castor oil, AA, in bbls | lb. | .12 — | .12½ |
| China wood oil, in bbls | lb. | .12½ — | .13 |
| Coconut oil, Ceylon grade, in bbls | lb. | .08¼ — | .08½ |
| Coconut oil, Cochin grade, in bbls | lb. | .09½ — | .09¾ |
| Corn oil, crude, in bbls | lb. | .11¼ — | .11½ |
| Cottonseed oil, crude (f. o. b. mill) | lb. | .08¼ — | .09 |
| Cottonseed oil, summer yellow | lb. | .11 — | .11¼ |
| Cottonseed oil, winter yellow | lb. | .12 — | .12½ |
| Linseed oil, raw, car lots (domestic) | gal. | .90 — | .91 |
| Linseed oil, raw, tank cars (domestic) | gal. | .86 — | .87 |
| Linseed oil, boiled, in 5-bbl lots (domestic) | gal. | .95 — | .96 |
| Olive oil, denatured | gal. | 1.15 — | 1.17 |
| Palm, Lagos | lb. | .07 — | .07¼ |
| Palm, Niger | lb. | .06¼ — | .06½ |
| Peanut oil, crude, tank cars (f.o.b. mill) | lb. | .09¼ — | .09½ |
| Peanut oil, refined, in bbls | lb. | .12¼ — | .12½ |
| Rapeseed oil, refined in bbls | gal. | .84 — | .85 |
| Rapeseed oil, blown, in bbls | gal. | .88 — | .89 |
| Soya bean oil (Manchurian), in bbls. N. Y. | lb. | .12 — | .... |
| Soya bean oil, tank cars, f.o.b., Pacific coast | lb. | .10 — | .... |

### FISH

| | | | |
|---|---|---|---|
| Light pressed menhaden | gal. | $0.51 — | .... |
| Yellow bleached menhaden | gal. | .53 — | .54 |
| White bleached menhaden | gal. | .55 — | .56 |
| Blown menhaden | gal. | .61 — | .... |
| Whale Oil, No. 1, crude, tanks, coast | gal. | .45 — | .48 |

## Miscellaneous Materials

All prices remain same as previous report

## Refractories

| | | |
|---|---|---|
| Bauxite brick, 56% $Al_2O_3$, f.o.b. Pittsburgh | per 1,000 | $130.00 |
| Chrome brick, f.o.b. Eastern shipping points | net ton | 40–42 |
| Chrome cement, 40-50% $Cr_2O_3$ | net ton | 24–32 |
| Chrome cement, 40-45% $Cr_2O_3$, sacks, in car lots, f.o.b., Eastern shipping points | net ton | 23.00 |
| Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works | 1,000 | 28–35 |
| Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works | 1,000 | 26–23 |
| Magnesite brick, 9-in. straight (f.o.b. works) | net ton | 56 |
| Magnesite brick, 9-in. arches, wedges and keys | net ton | 78 |
| Magnesite brick, soaps and splits | net ton | 90 |
| Silica brick, 9-in. sizes, f.o.b. Chicago district | 1,000 | 30–32 |
| Silica brick, 9-in. sizes, f.o.b. Birmingham district | 1,000 | 33–35 |
| Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa | 1,000 | 27–30 |
| Silicon carbide refractory brick, 9-in | 1,000 | 1100.00 |

## Ferro-Alloys

Quotations remain unchanged.

## Ores and Semi-finished Products

| | | | |
|---|---|---|---|
| Manganese ore, 50% Mn, c.i.f. Atlantic seaport | unit | .28 — | .29 |

All other prices remain quotably unchanged.

## Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

| | Cents per Lb |
|---|---|
| Copper, electrolytic | 13.875–14.00 |
| Aluminum, 98 to 99 per cent | 18.00–19.00 |
| Antimony, wholesale lots, Chinese and Japanese | 4.95–5.00 |
| Nickel, ordinary (ingot) | 36.00 |
| Nickel, electrolytic | 39.00 |
| Nickel, electrolytic, resale | 32.00–33.00 |
| Nickel, ingot and shot, resale | 30.00–31.00 |
| Monel metal, shot and blocks | 32.00 |
| Monel metal, ingots | 35.00 |
| Monel metal, sheet bars | 38.00 |
| Tin, 5-ton lots, Straits | 31.20 |
| Lead, New York, spot | 5.75 |
| Lead, E. St. Louis, spot | 5.45–5.50 |
| Zinc, spot, New York | 5.80–5.85 |
| Zinc, spot, E. St. Louis | 5.475–5.50 |

### OTHER METALS

| | | |
|---|---|---|
| Silver (commercial) | oz. | $0.70½ |
| Cadmium | lb. | 1.20–1.25 |
| Bismuth (500 lb. lots) | lb. | 2.00@2.10 |
| Cobalt | lb. | 3.00@3.25 |
| Magnesium, ingots, 99 per cent | lb. | 1.10 |
| Platinum | oz. | 90.00 |
| Iridium | oz. | 170.00@175.00 |
| Palladium | oz. | 55.00@ 60.00 |
| Mercury | 75 lb. | 55.00 |

## Structural Material

Prices remain quotably unchanged.

# Industrial

Financial, Construction and Manufacturers' News

## Construction and Operation

### Alabama

BIRMINGHAM—The plant and business of the San Nox Chemical Co., has been acquired by Charles Siegel and associates from James Johnston and H. H. Smithson, heretofore heads of the company. The company specializes in the manufacture of liquid soaps, polishes, etc. and the new owners plan for immediate extensions and improvements to approximately double the present capacity. New equipment will be installed.

### Arizona

SUPERIOR—The Magma Copper Co. has completed plans and will commence the immediate construction of its proposed new smelting plant, estimated to cost in excess of $500,000, including machinery. Contract for the steel framework for the building recently has been awarded.

### Arkansas

WESSON—The Edgar Lumber Co. has tentative plans under consideration for the construction of a new creosoting plant.

PENTERS BLUFF—The American Manganese Co. has acquired about 1,200 acres of land in Independence County with manganese and phosphate deposits, and plans for extensive development work. A plant will be installed for immediate production from a portion of the tract.

### California

SANTA CLARA—The National Stone Tile Co., San Francisco, is negotiating with the local Chamber of Commerce for a suitable site for the erection of a new plant. Plans will be prepared at an early date.

YUBA CITY—The Shell Oil Co., 343 Sansome Street, San Francisco, will soon commence the erection of a new local distributing plant, with equipment to provide for refined oils, lubricating oils and various byproducts. The plant will cost in excess of $30,000.

### Florida

TAMPA—The Riggs Chemical Laboratories are perfecting plans for extensive manufacture at their plant, and facilities will be provided for the production of a line of chemicals and byproducts. Walter B. Riggs and Theodore A. Bailey head the company.

### Illinois

WAUKEGAN—The City Council is having plans completed for the construction of a new filtration plant at the municipal waterworks. With pumping station and intake, the proposed plant will cost about $950,000. Hood, Decker & Drury, 303 South State St., Ann Arbor, Mich., are engineers.

PINCKNEYVILLE—The Atlas Powder Co. Delaware Trust Bldg., Wilmington, Del., has plans under way for the erection of a new local plant to consist of a number of 1-story buildings, estimated to cost about $100,000, including equipment. L. K. O'Brien is engineer in charge.

### Indiana

ANDERSON—The National Tile Co. will commence the immediate rebuilding of the portion of its plant, destroyed by fire, June 28, with loss estimated at about $40,000.

SCOTTSBURG—The plant of the J. W. P. Tire Co., defunct, with four acres of land, has been acquired by Clay Prosser and associates from the receiver, M. E. Smith. No announcement has as yet been made regarding the plans of the new owners.

### Maine

MINOT—The Rogers Fibre Board Co., is planning for the rebuilding of the portion of its plant, including power house, damaged by fire, July 3.

### Maryland

BALTIMORE—The Republic Gasoline Co., 308 Marine Bank Bldg., recently organized, is planning for the establishment of a plant in Kentucky, on site to be selected, for the manufacture of carbon black and affiliated specialties. G. I. Stafford is president, and C. R. Rishel, vice-president.

WILLIAMSPORT—The Conococheague Brick Co. is planning for enlargements in its plant, to include a new building for general manufacture and 3 kilns. The work is estimated to cost about $35,000.

FROSTBURG—The Frostburg Sewer Pipe Co., care of T. C. Carrington, secretary, Frostburg Commercial Club, has acquired a tract of land of about 33 acres, previously held by the Consolidation Coal Co., as a site for the erection of its proposed new plant for the manufacture of vitrified clay sewer pipe. Plans are being drawn for the initial buildings and it is planned to commence erection at an early date. The company was organized recently with a capital of $200,000.

BALTIMORE—The Water Bureau, William A. Megraw, water engineer, City Hall, will soon call for bids for the construction of the proposed new filtration plant at the city water works, to be 1-story, 245x295 ft., estimated to cost close to $1,000,000. William W. Emmert, Union Trust Building, is consulting engineer.

### Massachusetts

WOLLASTON—Fire, July 1, destroyed one of the buildings at the plant of the Norfolk Varnish Co., Arlington St., with loss reported at about $10,000. The structure will be rebuilt.

CAMBRIDGE—The Cambridge Rubber Co., 148 Main St., has filed plans for the construction of a new 1-story building at its works.

MALDEN—The Potter Drug & Chemical Corp. has tentative plans under consideration for the enlargement of its local plant, used primarily for the manufacture of soap products. It is proposed to discontinue the present London, Eng., factory, established during the war period and remove the equipment to the Malden plant, where all foreign production will be handled in the future.

SPRINGFIELD—The Springfield Gas Light Co., 35 State St., will construct a new holder and auxiliary plant on Page Blvd., to cost about $240,000. Contract for the holder has been awarded to the Bartlett, Hayward Co., Baltimore, Md.

### Michigan

ESSEXVILLE—The Aetna Portland Cement Co., 412 Union Trust Bldg., Detroit, is completing foundation work for a number of buildings at its proposed local plant and will soon commence superstructure work. The plant will cost close to $1,000,000, including machinery.

RIVER ROUGE—The Detroit Sand Lime Brick Co., 1008 Vinton Bldg., Detroit, has commenced excavations for the initial building at its proposed local plant, on site recently acquired. The works are estimated to cost in excess of $75,000.

### Missouri

POPLAR BLUFF—The Poplar Bluff Rubber Co. has secured a local building and plans for the immediate installation of equipment for the manufacture of rubber specialties. John H. Patterson is president and manager.

ST. LOUIS—The Mallinkrodt Chemical Works, Inc., 3600 North 2nd St., is reported to be planning for enlargements in its plant. The company recently increased its capital to $5,000,000. Edward M. Mallinkrodt is president.

ST. LOUIS—Machinery to cost about $30,000, will be installed in the proposed new plant to be constructed by the Superior Folding Box Co., 2311 Chestnut St. at Geraldine Ave. and Penrose St. The entire project will cost approximately $100,000.

### Nebraska

OMAHA—The Standard Chemical Mfg. Co., 1310 Harney St., has construction under way on a new 2-story plant, 60x114 ft., on Leavenworth St. near 41st St. Charles M. Nye, 737 Peters Trust Bldg., is architect.

### New Jersey

NEWARK—The Chemical Treatment Co. has leased property at 264 Jelliff Ave., comprising a 3-story and basement building, aggregating about 13,000 sq.ft., and adjoining property, 105x250 ft., for the establishment of a new plant for the manufacture of special chemical products. It is planned to commence the erection of a new building at an early date on the available vacant land.

PERTH AMBOY—The Novo Laboratories, Inc., manufacturers of chemical specialties, has commenced the construction of a new building at its plant No. 3.

GLOUCESTER CITY—The Armstrong Cork Co., South Camden, manufacturer of cork board and cork insulation products, has acquired the plant of the Ancona Co., Gloucester City, heretofore, used by the Welsbach Co., manufacturer of gas mantels, etc., for a consideration said to be $275,000. Adjoining property at Kings and Essex Sts., has also been purchased. The new acquisition will be used as an extension.

### New York

NIAGARA FALLS—The Defiance Paper Co., Walnut Ave., has broken ground for the construction of a 1-story addition, 50x200 ft., at Third and Walnut Sts., estimated to cost approximately $200,000, with machinery.

NEW YORK—The Mexican Petroleum Co., 120 Broadway, has commenced work on extensions and improvements at its oil terminal and distributing plant at Mata Rodonda, Mex., to cost about $300,000.

NEW YORK—The American Glass Bottle Co., 1179 Union Ave., has filed plans for the construction of a 1-story building, 65x79 ft., to cost about $12,000.

NIAGARA FALLS—The Kimberly & Clark Co., manufacturer of paper products, has foundation work under way for a 2-story addition to its local plant on the Niagara Falls Blvd., 60x100 ft. It is purposed to push the structure to completion for earliest possible occupancy.

### North Carolina

CANTON—The Champion Fibre Co. is arranging for the early occupancy of its new local plant, now nearing completion, for the manufacture of paper products. The mill will represent an investment of about $1,000,000, and will use three chemical processes for the utilization of paper pulp.

### Ohio

COLUMBUS—The Brown Steel Co., 480 Neilston St., manufacturer of steel products, will commence the immediate construction of a 1-story plant addition, 275x305 ft., estimated to cost approximately $150,000, with equipment. Charles W. Brown is general manager.

AKRON—The Anaconda Copper Co., 25 Broadway, New York, N. Y., has purchased property at Betts Corner, Akron, comprising about 9 acres of land for its proposed new plant, for the manufacture of zinc oxides and kindred specialties. Plans for the initial buildings are under way and it is expected to commence construction in September. The plant will be operated by the International Lead Co., a subsidiary organization. It is estimated to cost approximately $1,000,000, with machinery.

BEDFORD—The Mason Tire & Rubber Co., Kent, Ohio, has acquired the plant and property of the Owen Tire & Rubber Co. at Bedford, from Carl E. Friedolin, referee in bankruptcy, for a consideration of about $275,000. The plant is located on a 14-acre tract of land, and consists of a number of buildings. It will be used by the new owner for the manufacture of automobile tires and it is expected to develop an immediate capacity of 1,500 tires per day giving employment to about 200 operatives. The output will be increased in the near future, and the working force enlarged to close to 500 employees. O. M. Mason is president.

YOUNGSTOWN—The Youngstown Steel Co. will soon commence the construction of a new mechanical puddling plant, estimated to cost about $1,500,000. The mill will be operated under a new process and will

develop an output of about 250 tons of iron per day, giving employment to about 200 men. A blast furnace of about 500-ton capacity will be constructed in the near future.

## Oklahoma

SAND SPRINGS—A new 1-story foundry building will be constructed by the Tulsa Stove & Foundry Co., Tulsa, Okla., in connection with its proposed local plant, estimated to cost about $175,000.

## Pennsylvania

HIGH SPIRE—The Keystone Carbonic Gas Co. has broken ground for the construction of its proposed local plant, 60x140 ft., for the manufacture of carbonic gas and other commercial gas products, estimated to cost close to $250,000. S. S. Bailey, Security Trust Bldg., Harrisburg, Pa., is president.

PITTSBURGH—The Atlantic Refining Co., Chamber of Commerce Bldg., has acquired property in the Lawrenceville district, approximating 7½ acres of land bounded by 56th and 57th Sts. and the Allegheny River, in the vicinity of its present works, for a consideration of $350,000. It will be used for the construction of a new refinery addition.

WAYNESBORO—The Frick Co. will soon take bids on separate contracts for the erection of a 1-story foundry, 300x600 ft., estimated to cost about $200,000, with machinery. A. J. Frick is vice-president.

WILLIAMSPORT—The plant and property of the Nordmont Chemical Co., Nordmont, near Williamsport, devoted to the manufacture of wood alcohol, carcoal, and by-products, has been acquired by new interests, headed by Charles W. Jones, Williamsport. The plant will be continued in operation for a certain time, and later will be dismantled, the machinery to be removed to another location.

MORRISVILLE—The Robertson Art Tile Works has construction under way on a new 1- and 2-story building at its plant, 110x160 ft., to be used for general production and operations.

## South Carolina

HAMBURG—The Hankinson Brick Co. is said to be planning for the rebuilding of the portion of its plant, including kilns, destroyed by fire June 30. An official estimate of loss has not been announced.

## Texas

STAMFORD—The Williams-Miller Gin Co., Elks City, Okla., operating cotton gineries, is planning for the construction of a new cotton oil mill on property at Stamford, estimated to cost about $150,000.

LLANO—The Honey Creek Minerals Co. has plans under way for the construction of a new refining plant and laboratory at its molybdenite ore properties, estimated to cost about $150,000. The company will also install considerable new machinery in different departments of its works to cost approximately $100,000.

DALLAS—The Taxa Cola Co. of America, recently organized under Delaware laws, with a capital of $2,000,000, has plans under way for the construction of a 2-story plant on local site, for the manufacture of extracts. It is also proposed to construct a number of branch plants in different cities of the state, and sites have been selected at Galveston and Mexia. John H. Wood, Dallas, is secretary and acting treasurer in charge.

## Washington

SEATTLE—The Washington Iron Works, Seattle Blvd., and Norman St., will construct a 1-story foundry, 130x140 ft., in connection with a number of plant additions, estimated to cost about $500,000. The foundry will be used for the production of steel and grey iron castings. Gerald Fink is president.

## West Virginia

HUNTINGTON—R. E. Morrison, Huntington, is organizing a new company with capital of $50,000, to construct and operate a local plant for the manufacture of soap products. A site is being selected and erection will be commenced at an early date.

## Canada

THREE RIVERS, QUE.—The Three Rivers Pulp & Paper Co. is said to have preliminary plans in progress for the construction of a new mill on local site, estimated to cost close to $2,500,000, with machinery. Work will be commenced within 60 days.

# New Companies

THE UNITED STATES PAPER CO., Jersey City, N. J., has been incorporated with a capital of $100,000, to manufacture paper products. The incorporators are Robert P. Gilman, J. Frank Finn, and Frank W. Hastings, Jr., 15 Exchange Place, Jersey City.

THE PENNSYLVANIA POTASSIUM PHOSPHATE CO., Philadelphia, Pa., is being organized by Frank V. McMullin, Harrison B. Price and Edwin Smiley, all of Philadelphia, to manufacture phosphatic and other fertilizer and chemical products. Application for a state charter will be made on July 24. The company is represented by Joseph R. Embery, 1105-6 Real Estate Trust Bldg., Philadelphia.

THE LEAD KOTE PROCESS, INC., New York, care of Slade & Slade, 200 Broadway, representatives, has been incorporated with a capital of $100,000, to manufacture galvanizing products for steel treatment. The incorporators are M. Robinson, I. Levin and L. C. Brady, all of New York; the company will operate a local plant.

THE LOUIS ROSE BRICK CO., Highland Park, Mich., has been incorporated with a capital of $100,000, to manufacture brick and other burned clay products. The incorporators are John P. Scallen, George W. Handloser, and Louis Rose, 169 Eason Ave., Highland Park.

THE HUB PAINT REMOVER CO., Boston, Mass., has been incorporated with a capital of $50,000, to manufacture paint removers and other chemical products. Reuben Hall, 70 State St., Boston, is president and treasurer; Alfred Hall is vice-president.

THE MAURICE CHEMICAL CO., 1545 South Charles St., Baltimore, Md., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture refractory cements, glazing materials, etc. The incorporators are F. Howard Kidd, W. Frank Reed and Joseph R. Hudson.

THE GRISWOLD OIL CORP., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $15,000,000, to manufacture petroleum products.

THE PERTH AMBOY CO., 303-5 Front St., Perth Amboy, N. J., has filed notice of organization to manufacture chemicals and chemical byproducts. The company is headed by Arden D. Cline and Willis H. Landis, Elizabeth, N. J. The last noted represents the company.

THE ORLANDO PERFECT PRODUCTS CO., Jacksonville, Fla., has been incorporated with a capital of $100,000, to manufacture fertilizer products. F. E. Clark is president; A. L. Morgan, vice-president; and E. W. Mitchell, secretary, all of Jacksonville.

THE ELLIOTT PETROLEUM CO., Los Angeles, Calif., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are J. E. Elliott, Floyd C. Merritt and M. E. Davis, all of Los Angeles; and A. M. Goodhue, Long Beach, Cal. The last noted represents the company.

THE MILLARD LEATHER CO., Attleboro, Mass., has been incorporated with a capital of $80,000, to manufacture leather products. Harry S. Millard is president; and Karl B. Brooks, Attleboro, treasurer.

THE MET-ARBOR CO., Norwalk, Conn., has been incorporated with a capital of $50,000, to manufacture soaps, chemicals, etc. The incorporators are William Krusch, Coleburn Block, F. J. G. Hardy and W. T. Krusch, all of Norwalk.

F. BREDT & CO., INC., New York, care of F. S. Rauber, 38 Park Row, representative, has been incorporated with a capital of $50,000 to manufacture chemicals and chemical byproducts. The incorporators are G. C. Orth, H. A. Fanning and L. B. Lebowitz.

THE PENETRATOR CO., INC., Lakewood, N. J., has been incorporated with a nominal capital of $2,000, to manufacture oils, compounds, etc. The incorporators are Max Jerry, M. E. and John A. Meyers, 215 4th St., Lakewood.

THE ELECTROCAST STEEL FOUNDRY CO., 920 West Kinzie St., Chicago, Ill., has been incorporated with a capital of 300 shares of stock, no par value, to manufacture steel castings. The incorporators are Alfred Johnson, Daniel B. Abrahamson and Adolph J. Peterson.

THE HANNIGAN WATER PROOFING & MFG. CO., Milford, Conn., care of Woodburn Martin, Georgetown, Del., representative, has been incorporated under Delaware laws with capital of $50,000, to manufacture waterproofing products and affiliated specialties. The incorporators are M. A. and Thomas Hannigan, and L. U. Berger, all of Milford.

THE LESLIE GROVE OIL CO., Newark, O., has been incorporated with a capital of $50,000, to manufacture oil products. The incorporators are Leslie Grove and Calvin C. Jeffries, both of Newark.

THE PIED PIPERS OF AMERICA, INC., New York, N. Y., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The company is represented by M. A. Vogel, 291 Broadway. The incorporators are D. A. Bach, and W. S. Patjans.

THE CALIFORNIA-MAINE OIL CO., Portland, Me., care of M. F. Foster, Portland, representative, has been incorporated with a capital of $1,000,000, to manufacture petroleum products. R. L. Johnson is president; and A. B. Farnham, treasurer.

THE DOMINION PORTLAND CEMENT CO., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., has been incorporated under Delaware laws, with a capital of $2,000,000, to manufacture portland cement.

THE KLENNIT-CHEMICAL CO., Fort Worth, Tex., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are L. W. Bevans, L. D. Patterson and T. B. Yarborough, all of Fort Worth.

THE ROGERS ASBESTOS CO., Houston, Tex., has been incorporated with a capital of $40,000, to manufacture asbestos products. The incorporators are E. M. Rogers, W. W. Bates and S. H. Rudnick, all of Houston.

EISELE & CO., INC., Nashville, Tenn., care of George M. Jones, Dover, Del., has been incorporated under Delaware laws with a capital of $154,000, to manufacture chemical specialties, chemical byproducts, drugs, etc. The incorporators are A. B. Benedict, William Nelson and C. Logan Eisele, Nashville.

THE AMERICAN ROCK ASPHALT CO., Valliant, Okla., has been incorporated with a capital of $100,000, to manufacture asphalt and affiliated products. The incorporators are H. C. Clark, Valliant; Ralph P. Taylor and T. E. Webber, both of Texanna, Okla.

THE GRASS LAKE MUTUAL OIL CO., Adrian, Mich., has been incorporated with a capital of $10,000, to manufacture refined mineral oils. The incorporators are Arthur F. Messner and Warren K. Raby, both of Grass Lake, Mich.; and Rolland C. Rothfuss, 404 National Bank of Michigan, Adrian. The last noted represents the company.

THE WEST PHILADELPHIA CUT GLASS CO., Philadelphia, Pa., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $100,000, to manufacture glass products.

THE COMMERCIAL ASBESTOS CO., Seattle, Wash., care of the Commonwealth Finance Co., Securities Bldg., Seattle, representative, has been incorporated with a capital of $250,000, to manufacture asbestos products. Charles C. Franklin is the principal incorporator.

THE CARDINAL OIL CORP., Portland, Me., has been incorporated with a capital of $6,500,000, to manufacture petroleum products. R. L. Johnson is president; M. F. Foster, treasurer; and A. B. Farnham, Portland, clerk. The last noted represents the company.

THE CROCKETT COTTON OIL MILL, INC., Crockett, Tex., has been incorporated with a capital of $100,000, to manufacture cotton oil products. The incorporators are J. Legory, G. Q. King and J. S. Shivers, all of Crockett.

THE SUFFOLK LEATHER CO., INC., Boston, Mass., has been incorporated with a capital of $10,000, to manufacture leather products. Hugh J. Shaw is president and I. Stebbins Gilbert, 345 Ashmont St, Dorchester, Mass., treasurer.

THE BEATS-AWL CO., 57 Main St., East Orange, N. J., has filed notice of organization to manufacture chemical specialties, vermin exterminators, etc. Edwin S. Douglas heads the company.

THE UNITED STATES TANNING CO., Philadelphia, Pa., is being organized by A. and Nathan Rathblott, and Carl S. Gross, all of Philadelphia, to manufacture leather products. Application for a state charter will be made on July 24. The company is represented by Sundheim, Folz & Kun, 1516 Real Estate Trust Bldg., Philadelphia.

THE HINCKLEY CORP., Hinckley (Herkimer County), N. Y., care of Dunmore, Ferris & Dewey, Utica, N. Y., representative, has been incorporated with a capital of $20,000, to manufacture sulphite products. The incorporators are T. H. Ferris, F. W. Newton and T. Burgess.

# Capital Increases, Etc.

THE EMPIRE STATE PAPER CORP., 216 Seventh Ave., New York, has filed notice of increase in capital from $50,000 to $100,000.

Robert E. Cowden, receiver for the MASTER TIRE & RUBBER CO., Dayton, O., is arranging for the sale of the property and assets of the company, consisting of a main 1-story plant, 70x216 ft., and smaller buildings, with machinery. Bids will be received until July 26.

THE ALBANY MALLEABLE IRON CO., Albany, N. Y., has filed notice of a reduction in capital from $500,000 to $250,000.

THE HUMBLE OIL & REFINING CO., Houston, Tex., operating oil refineries, is disposing of a bond issue of $25,000,000, the proceeds to be used in part for extensions and improvements. W. S. Farish is vice-president.

THE AETNA STEEL PRODUCTS CO., 30 Church St., New York, N. Y., has filed notice of dissolution under state laws.

THE CONNECTICUT HARD RUBBER CO., New Haven, Conn., has filed notice of increase in capital from $10,000 to $50,000.

THE C. H. MILLS OIL CO., Syracuse, N. Y., has filed notice of increase in capital from $200,000 to $1,000,000, for proposed expansion.

THE B. F. GOODRICH CO., Akron, O., manufacturer of automobile tires and other rubber products, is disposing of a bond issue of $20,000,000, a portion of the proceeds to be used for extensions and improvements.

THE ZENITH FURNACE CO., Duluth, Minn., producer of pig iron, coke, etc., is disposing of a bond issue of $1,000,000, a portion of the proceeds to be used for extensions and improvements. W. B. Castle is president.

E. W. Bowen, Delphi, Ind., has been appointed receiver for the INDEPENDENT OIL CO., Delphi and Frankfort, Ind., succeeding Silas Wilson.

A merger of the MARSHALL OIL CO. and the WEST VIRGINIA PETROLEUM CO., Morgantown, W. Va., has been arranged under the first noted name. The consolidated organization will operate with a capital of $1,000,000.

Receivers for the TEXAS STEEL CO., Rusk, Tex., have made application to the District Court for permission to sell the plant and property of the company. The proposed sale will be held on Sept. 15.

The plant of the PLANTERS' COTTON OIL CO., Dallas, Tex., will be sold under foreclosure proceedings. The property represents an investment of close to $300,000.

THE UNITED STATES REFRACTORIES CO., Mount Union, Pa., has perfected arrangements for an increase in capital from $300,000 to $1,400,000.

The plant and property of the LYNCHBURG GLASS CO., Lynchburg, Va., which recently assigned, will be sold at auction for the benefit of creditors.

DWIGHT P. ROBINSON & COMPANY, Engineers and Constructors with main offices in New York City and branch offices in Chicago, Los Angeles, Montreal, Youngstown, Dallas and Rio de Janeiro, Brazil, has recently entered into a contract with the Metropolitan Life Insurance Co. by which life insurance policies are provided without expense to individuals for all members of its organization reporting to the central office under a group insurance plan. This insurance is without cost to the employees and its benefits are in addition to those provided by law under the various State Workmen's Compensation Acts. All employees included in the Plan are insured regardless of their age and condition of health and no medical or physical examination is required. The amount of insurance is increased $100 for each additional year of continuous employment and this plan of regular increase is thus a recognition of length of service.

THE ECONOMY FUSE & MFG. CO. of Chicago, Ill., announces the appointment of Charles H. Bluske as district sales manager of the Los Angeles office at 1304 Maltman Avenue. Mr. Bluske was formerly connected with the Pacific States Electric Co. of Los Angeles, and succeeds George L. Davis. The Pittsburgh Sales Office of the Economy Fuse & Mfg. Company has been moved from 2223 Farmers Bank Building to 1006 Peoples Bank Building at Fourth Ave. and Wood St.

THE U. S. ELECTRO GALVANIZING CO., Inc., announces change of name to U. S. Galvanizing & Plating Equipment Corporation, with main office and factory at 32 Stockton Street, Brooklyn, N. Y.

PAUL O. ABBE, INC., 71-73 Murray Street, New York City, announces the return of Max F. Abbe, who has been living retired for the past ten years. If his health permits him to do so, he will become the chairman of the board of directors of the company.

F. J. RYAN & Co., industrial furnace engineers, Philadelphia, Pa., held its annual meeting at the company's new offices on the 6th floor of the Wesley Building. This is the second increase of facilities of the company within the last year and a half, made necessary by the increasing amount of business. At the election of officers, F. J. Ryan was re-elected president; W. W. Posey (president of Lancaster Iron Works, Lancaster, Pa.) was elected vice-president; A. C. Scully (treasurer of Lancaster Iron Works) was elected treasurer and Miss E. N. Kraske was re-elected as secretary. S. R. Vanderbeck of Philadelphia was re-elected as director. G. F. Beach, who for a number of years had been chief engineer of the Mircs Furnace Departments of the Lancaster Iron Works and who came into a like position with the Ryan Co. after a consolidation of interests of the Mircs Co. and the Ryan Co., was retained in the same position. Additional departments have been decided upon in the line of Producer Gas and Regenerator Furnaces. This work will be under the direction of Karl G. Gustafsson, who has had considerable experience in this line of work in foreign countries, especially Germany and France. Mr. Gustafsson brings with him the results of the necessity of foreign conservation in furnace work.

# Industrial Developments

CERAMIC—The Briggs Co., Lansing, Mich., manufacturer of face brick, has adopted a capacity operating schedule at its plant at Grand Ledge, Mich., on a basis of 40,000 to 45,000 bricks per day. Orders on hand insure this rate of production for a number of months to come.

The Robertson Art Tile Works, Morrisville, Pa., is running on a day and night schedule at its plant, with incoming orders in excess of production. Contracts on hand insure maximum output for some time to come.

The Model Brick Co., Houston, Tex., has placed its plant on the Crosby Road in operation, following curtailment for a considerable period. Production will be maintained for an indefinite period on a basis of 20,000 bricks per day.

RUBBER—The Hood Rubber Co., Watertown, Mass., is maintaining capacity production at its local mills, and reports orders ahead for some time to come. The sales for the first five months of the year have registered an increase of $1,200,000 in excess of those for the corresponding period of Jan. 1 to June 1, last year.

Tire production at Akron, Ohio, reached an aggregate of 2,500,000 tires at the different mills during the month of June, or a rate of 85,000 casings per day.

The Goodyear Tire & Rubber Co., Akron, Ohio, has resumed operations at its local mills, following a brief shut down for inventory. The plant will continue on a capacity basis of 26,000 casings a day.

During the month of June, the Firestone Tire & Rubber Co., Akron, Ohio, recorded the highest sales in the history of the organization. It is expected to advance the current output of 25,000 tires a day at an early date. The peak production at the plant is rated at 28,500 tires daily.

OIL—The Rex Refining Co., Sweetwater, Tex., recently reorganized under the direction of A. M. Slade, and associates, Fort Worth, Tex., has resumed operations following a shut down for more than a year past. It is expected to develop maximum production at an early date.

The Vacuum Oil Co., Paulsboro, N. J., has adopted an operating basis of close to normal at its local plant. A regular working force is being employed.

IRON AND STEEL—The Algoma Steel Co., Sault Ste. Marie, Ont., has resumed operations at two of its furnaces, and a third will be placed in service at an early date. The rail mill at the works has been placed in operation, following a period of curtailment and will be run on a capacity basis for an indefinite period.

The Republic Iron & Steel Co., Youngstown, Ohio, has resumed operations at its Bessemer plant, following a shut down for the past 18 months. About 700 men will be employed at the mill. The starting of the mill brings the Bessemer production in the valley to 100 per cent.

The Gulf States Steel Co., Birmingham, Ala., has placed its 20-inch bar mill in operation, following a shut down for about 18 months past.

The Carnegie Steel Co. has blown in the fourth blast furnace at its plant at New Castle, Pa., placing the works on a full operating basis, with regular working force.

The Eastern Rolling Mills Co., Baltimore, Md., has adopted a capacity operating schedule at its local plant on a 24-hour per day basis, giving employment to about 1,200 men.

# New Publications

## BOOKS

CHEMISCHE UNTERSUCHUNGSMETHODEN FÜR EISENHÜTTEN UND NEBENBETRIEBE. By *Ing. Chemiker Albert Vita.* Second and revised edition. 197 pp., 34 illustrations. Published by Julius Springer, Berlin (1922), 78 marks (in America, $1.90).

A concise, but nevertheless thorough, compilation of important analytical methods not only for iron and steel, but for coal, gas, coal tar and its products and the more important non-ferrous metals. It is a book of handy size and is well printed and illustrated.

"Electro Steam Boiler" is the title of a pamphlet recently issued by the Electric Furnace Construction Co., Philadelphia, Pa.

Further Investigations of Illinois Fire Clays. By C. W. Parmelee and C. R. Schroyer. Extracts from Bulletin No. 38, State Geological Survey, Urbana, Ill.

The *Journal of Personnel Research*, the official organ of the Personnel Research Federation published its first issue in May, 1922. This *Journal* publishes original articles by workers in the biological and medical sciences, psychologists, pschiatrists, engineers and economists who are making important contributions to the knowledge of human beings at work and will serve men who are interested in activities that pertain to personnel in industry, commerce, education and government. The magazine is published by Williams & Wilkins Co., Baltimore, Md.

Scovell, Wellington & Co., accountants-engineers, Boston, Mass., have issued a small booklet entitled "Selected Professional and Business Books" which contains a list of 400 books on accountancy, industrial engineering and related business topics. This list has proved useful to them and they think it will be helpful to anyone who is interested in building up a library.

The Hercules Powder Co., Wilmington, Del., has issued a booklet entitled "Dynamite—The New Aladdin's Lamp." This article was written by T. W. Bacchus, vice-president of the company. It is an interesting and accurate account of the part played by dynamite in the industrial development of this country. Copies may be obtained free by addressing the Hercules Powder Co., Wilmington, Del.

THE MINING HAND BOOK OF CANADA, 1922, covering the metal, mining and oil industries of Canada, has recently been published by the Investor's Mining Hand Book Co., Toronto, Canada. Paper bound copies are $1 and leather bound are $2 per copy.

# Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold a summer excursion meeting to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo, Aug. 13-19.

AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

THE SOCIETY OF INDUSTRIAL ENGINEERS will hold its next national convention and exhibitions of labor-saving equipment at the Hotel McAlpin, New York, October 18, 19 and 20.